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DRAFT ENVIRONMENTAL ASSESSMENT

INSTALLATION OF FLUE GAS DESULFURIZATION SYSTEM AT BULL RUN FOSSIL PLANT

Anderson County, Tennessee

TENNESSEE VALLEY AUTHORITY

JANUARY 2005

Proposed project: Installation of Flue Gas Desulfurization (Scrubber) System at Bull Run Fossil Plant
Anderson County, Tennessee

Lead agency: Tennessee Valley Authority

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Abstract: The Tennessee Valley Authority (TVA) has prepared a Draft Environmental Assessment (DEA) of a proposal to reduce sulfur dioxide (SO_2) emissions at Bull Run Fossil Plant (BRF) by installing flue gas desulfurization equipment that employs the wet limestone forced oxidation technology. TVA needs to reduce systemwide SO_2 emissions to meet requirements under the 1990 Clean Air Act amendments. Reductions at BRF would help TVA meet those requirements. This DEA considers the impacts of the No Action Alternative and several variations of the Action Alternative.

Issue areas identified in scoping of potential environmental impacts and subsequently analyzed in the DEA were air resources; transportation; visual resources; noise; water; solid waste; flood risk and navigation; aquatic life; terrestrial ecology; endangered, threatened, and rare species; wetlands; natural areas; cultural resources; socioeconomics; and environmental justice.

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CHAPTER 1

1. PURPOSE, NEED, BACKGROUND, AND SCOPING

1.1. Purpose and Need for the Proposed Action

The purpose of the proposed project is to reduce sulfur dioxide (SO_2) emissions from Bull Run Fossil Plant (BRF) by installing flue gas desulfurization (FGD) or scrubber equipment that employs the wet limestone forced oxidation (LSFO) technology. The Tennessee Valley Authority (TVA) needs to reduce systemwide SO_2 emissions to meet requirements under the 1990 Clean Air Act amendments. Reductions at BRF would help TVA meet those requirements.

The scrubber would assist TVA in maintaining compliance with the United States Environmental Protection Agency's (USEPA) Title IV regulations for the Acid Rain Program. The Title IV regulations require reductions and caps for utility industry SO_2 emissions. Compliance with the regulations is based on emission allowances. TVA's current SO_2 allocation allowance per year is approximately 430,000 tons. In 2003, TVA's emissions were 583,000 tons, and compliance was maintained by utilizing banked SO_2 emission allowances.

1.2. Background

In TVA's continuing efforts to improve air quality in the Tennessee Valley and to comply with the Clean Air Act, TVA is considering to potentially design, build, and operate as many as five FGD systems to reduce SO_2 emissions from TVA's coal-fired power plants. TVA is currently installing an FGD system at Paradise Fossil Plant (PAF) Unit 3 in Kentucky. Additionally, TVA is contemplating the installation of scrubbers at Kingston Fossil Plant (KIF) in Tennessee (all nine units at KIF may be controlled by two FGD systems) and at Colbert's (COF) Unit 5 in Alabama. These five FGD systems would cost approximately $1.5 billion and would collectively reduce emissions of SO_2 by more than 200,000 tons per year, bringing TVA's total emissions down by 85 percent since 1977. The locations of the systems are expected to provide the greatest environmental benefit for the investment in dollars and to improve air quality regionally.

This Environmental Assessment (EA) describes the impacts of constructing and operating an FGD system to serve BRF. For KIF and COF, the dates and order of the FGD systems will be determined through engineering studies that will be completed over the next several months. As pollution control technology improves in the future, TVA may potentially shift to other technology. In any event, financial and environmental reviews will also be prepared for the FGD project(s) at KIF and COF as engineering design and technology information for those plants becomes sufficiently detailed to support an accurate and complete environmental review.

1.2.1. Bull Run Fossil Plant

BRF is located in Anderson County, Tennessee, about 5 miles east of downtown Oak Ridge and 13 miles west of Knoxville (Figure 1-1). The plant site is located on a 750-acre reservation on the east side of TVA's Melton Hill Reservoir (Clinch River Mile [CRM] 48). The plant adjoins Edgemoor Road between U.S. Highway (US) 25 and State Route (SR) 62. Most nearby lands are U.S. Department of Energy (DOE) reservation properties for the Oak Ridge facilities, but residential and recreational areas are in close proximity. The closest residences are directly across Edgemoor Road from the plant reservation.

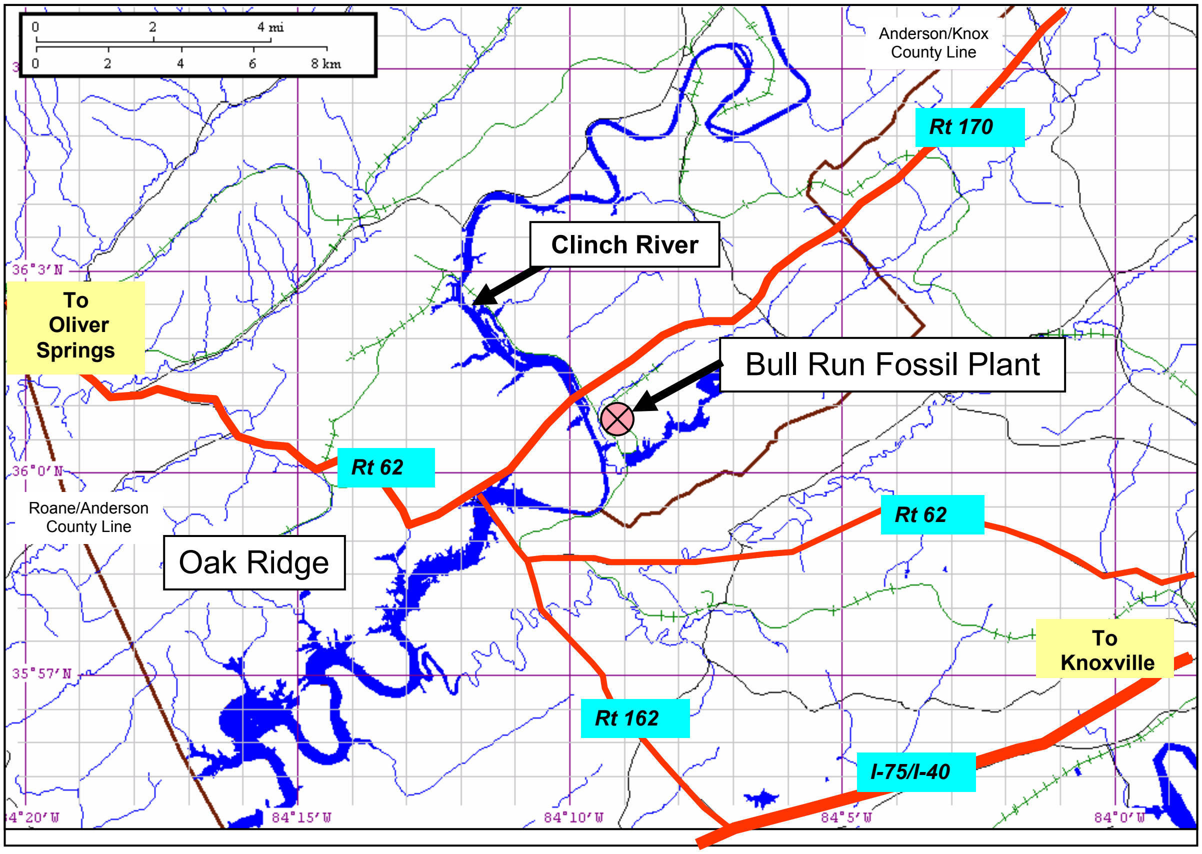


Figure 1-1. Location of Bull Run Fossil Plant

The plant was built between 1962 and 1966. First commercial operation began in June 1967. Nameplate generating capacity for the single unit is 950 megawatts (MW). It is the only single-generator coal-fired plant in the TVA system. Winter net-dependable generating capacity is about 881 MW. BRF generates about 6.5 billion kilowatt-hours of electricity in a typical year, or enough energy to meet the needs of 460,000 homes.

Each of the two tangentially fired boilers at BRF is of a pulverized-fired, once-through supercritical design. Coal consumption for BRF is approximately 2.2 million tons per year. The coal combustion process produces sulfur oxides, nitrogen oxides (NOx) and ash particles (called fly ash or particulate). Large concentrations of these pollutants may adversely affect human health, vegetation, and wildlife. To remove fly ash and reduce stack opacity, electrostatic precipitators (that are more than 99 percent efficient) were installed in 1978. The state air permit's general limit (excluding allowances for startup, shutdown, malfunction, and certain other episodes) for opacity at BRF is 20 percent, but the plant typically operates at less than 10 percent opacity. The installation of low-NOx burners with separate overfire air to reduce NOx emissions was considered in the late 1990s, but not implemented because of TVA's decision to employ more efficient NOx-control technology known as Selective Catalytic Reduction (SCR). In 1999, TVA completed a combustion-optimization project to reduce NOx emissions. SCR systems were placed in operation at BRF in April 2004. These systems reduce NOx emissions by up to 90 percent. Low-NOx burners, although much more economical, are less effective at lowering NOx emissions (typically 40 to 50 percent). SCR uses a catalyst to promote the chemical reaction between NOx and a nitrogenous compound, generally ammonia, to produce molecular nitrogen and water. Gaseous emissions from burning coal currently are dispersed through an 800-foot stack.

1.2.2. Sulfur Dioxide Emissions and Control Technologies

Sulfur is present in coal as an impurity and reacts with oxygen to form SO_2 when the coal is burned to generate electricity. Reduction of SO_2 emissions has typically been achieved through one or a combination of the following:

- Use of fuel desulfurization methods
- Switching to lower-sulfur fuels
- Use of FGD systems

TVA utilizes all of these techniques in meeting regulatory requirements at its 11 coal-fired plants. Each of these options has its own costs and benefits; however, there is no single universal solution. Fuel desulfurization occurs through the washing of coal before it is burned. Coal washing is effective in reducing pyrite content (small, discrete iron sulfide particles in the coal), but is not effective for removing the organic sulfur from the coal matrix. Organic sulfur accounts for 35 to 75 percent of the total sulfur content of coals burned in many TVA power plants.

The current strategy for maintaining compliance at BRF involves the use of low-sulfur fuel from eastern Kentucky and Tennessee. Figure 1-2 shows the historical annual SO_2 emissions in tons per year and pounds per unit of heat input for BRF. The sulfur content of the coal used at BRF has ranged from 1.4 to 2.3 pounds (lb) SO_2/million British thermal units (mmBtu) since 1978. The plant operated at or below 1.5 lb SO_2/mmBtu from 2000 through 2004. The current State Implementation Plan's (SIP) SO_2 limit for BRF is 4.0 lb SO_2/mmBtu.

Because of its size and the time of its commencement of operation (1965), BRF would be covered under the 1977 Clean Air Act amendments (Section 169a) as needing Best Available Retrofit Technology (BART) to reduce visibility impairment. The visibility protection requirements were promulgated by USEPA in regulations codified in 40 Code of Federal Regulations (CFR) Part 51, Subpart P. Adding LSFO scrubbers to BRF, which is essentially the best technology available for controlling SO_2 emissions from large coal-fired utility units, would satisfy BART requirements.

The USEPA-promulgated regional haze regulations on July 1, 1999, with a goal of pristine visibility at all Class I areas (national parks) by 2064. Like the $PM_{2.5}$ (particulate matter with a diameter less than or equal to 2.5 micrometers) National Ambient Air Quality Standards (NAAQS), this rule targets the reduction of fine particulates. The rule calls for visibility improvements to be achieved incrementally in 10-year-planning cycles. The first 10-year plan is due in 2008, with subsequent plans due every 10 years thereafter. In its May 24, 2002, decision, the Circuit Court of Appeals for the District of Columbia vacated in part and remanded to USEPA its Regional Haze Rule. Under a consent decree with the Environmental Defense Fund, USEPA is now mandated to address the issues vacated by the federal court in a final rule to be promulgated no later than April 15, 2005.

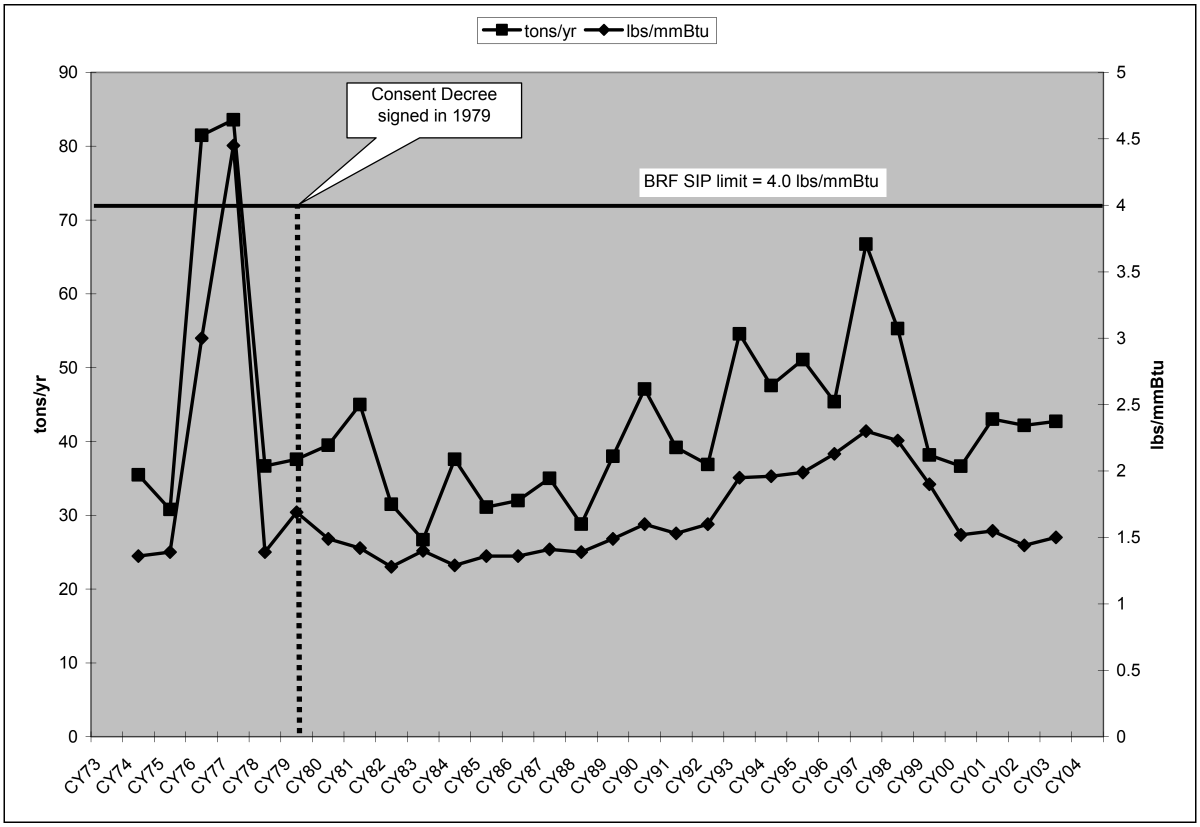


Figure 1-2. Historic Bull Run Fossil Plant Sulfur Dioxide Emissions

A regional haze control strategy is being developed for a 2008 implementation date. The plan currently targets SO_2 and NOx-control technologies on units subject to BART requirements and allows for trading on a limited basis. BART requirements apply to fossil-fuel-fired steam generating units that began operation on or after August 7, 1962, and began construction before August 7, 1977. TVA plans to have scrubbers on all of its BART units (BRF, COF5, Cumberland Fossil Plant [CUF], PAF, and Widows Creek Fossil Plant Unit 8) in time to meet the initial visibility control strategy.

The FGD technology review for BRF was based on TVA performance needs, compatibility with existing facilities at the plant, costs, availability of fuels, and maintenance procedures. TVA additionally required that the technology be commercially available and fully demonstrated on utility coal-fired plants larger than 100 MW and burn medium- to high-sulfur coal (greater than [>] 3 lb/mmBtu).

The Scoping Process

A TVA interdisciplinary team reviewed the potential direct, indirect, and cumulative effects of the proposed use of LSFO technology at BRF for SO_2 reduction. From this review, the following project aspects were identified for detailed analyses.

- Air
- Transportation
- Visual Resources
- Noise
- Surface Water and Wastewater
- Flood Risk and Navigation
- Aquatic Life
- Terrestrial Ecology
- Endangered, Threatened, and Rare Species (Animals, Aquatics, and Plants)
- Wetlands
- Natural Areas
- Cultural Resources
- Socioeconomics
- Environmental Justice

1.3. Related TVA National Environmental Policy Act (NEPA) Documents

- Installation of Flue Gas Desulfurization (Scrubber) System on Paradise Fossil Plant Unit 3 (Muhlenberg County, Kentucky) Environmental Assessment, March 2003 (TVA, 2003)
- Bull Run Fossil Plant Unit 1 Selective Catalytic Reduction System for Nitrogen Oxide Control Environmental Assessment, March 2002 (TVA, 2002a)
- Grant of Easement for Industrial Development - Bull Run Fossil Plant - Environmental Assessment, January 1998 (TVA, 1998)
- Energy Vision 2020 - Integrated Resource Plan Environmental Impact Statement, December 1995 (TVA, 1995)
- Coal Combustion Byproduct Marketing Environmental Assessment, February 1990 (TVA, 1990)

1.4. Public and Agency Involvement

Concurrent with public review, this Draft EA will be sent to the agencies listed below for comments:

- National Park Service
- Tennessee Department of Environment and Conservation
- United States Army Corps of Engineers
- United States Fish and Wildlife Service

CHAPTER 2

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. The Proposed Action

The proposed action is to construct and operate an FGD (scrubber) system at BRF. The project is intended to reduce SO_2 emissions by at least 95 percent at full load conditions. The scrubber(s) would utilize wet LSFO technology because of its high SO_2 removal performance and excellent reliability. An absorber would be constructed along with those subsystems and utilities necessary to support its operation. A limestone receiving, handling facility would be constructed to provide the reagent needed in the scrubbers. This aspect has three options: Option 1 is delivery by truck, Option 2 is delivery by barge, and Option 3 is delivery by rail. Additional construction could include a gas handling system to transport flue gas from the existing precipitators to the absorber, a new stack, water supply systems, fire control systems, power supply and control systems, a gypsum dewatering facility, facilities for transporting gypsum to market via truck, barge, or rail, and a wet-ponded gypsum disposal area (for gypsum that could not be marketed). The new disposal area would not require any additional acreage; however, it would require modifications to the current ash disposal area.

The current proposal contemplates construction to begin on the BRF scrubber potentially as soon as May 1, 2005, with operation starting about October 2008. Regardless of the preliminary schedule, the scrubber would be operational no later than 2010. The scrubber would be designed and constructed to achieve various electricity production goals and to maximize operational flexibility. Most of the plant and its operation would remain the same after the new scrubber is in place. Due to the high removal efficiency of the scrubber, more higher-sulfur coal may be burned than is currently burned, but the overall result would be a substantial reduction in SO_2 emissions. The scrubber would be installed downstream of the current particulate and NOx-control systems.

The footprint for the proposed FGD system is shown in Figure 2-1. Figures 2-2a, b, c, and d show more detailed drawings of these facilities. Following is a brief description of the major components and systems of the proposed scrubber and their operational aspects.

2.1.1. The Absorber

A single absorber is under consideration for the proposed project. The single-tower design can typically provide 95 percent SO_2 removal. The design, which is proposed for this project, has lower power requirements and can deliver SO_2 removal performance at least 95 percent when burning medium- to high-sulfur coals.

The typical absorber consists of a limestone slurry/flue gas contact area and mist eliminators. The preliminary design for the absorber would be approximately 70 feet by 104 feet with a height around 81 feet. The slurry elevation in the reaction tank would be approximately 20 feet, giving a total volume of approximately 1 million gallons.

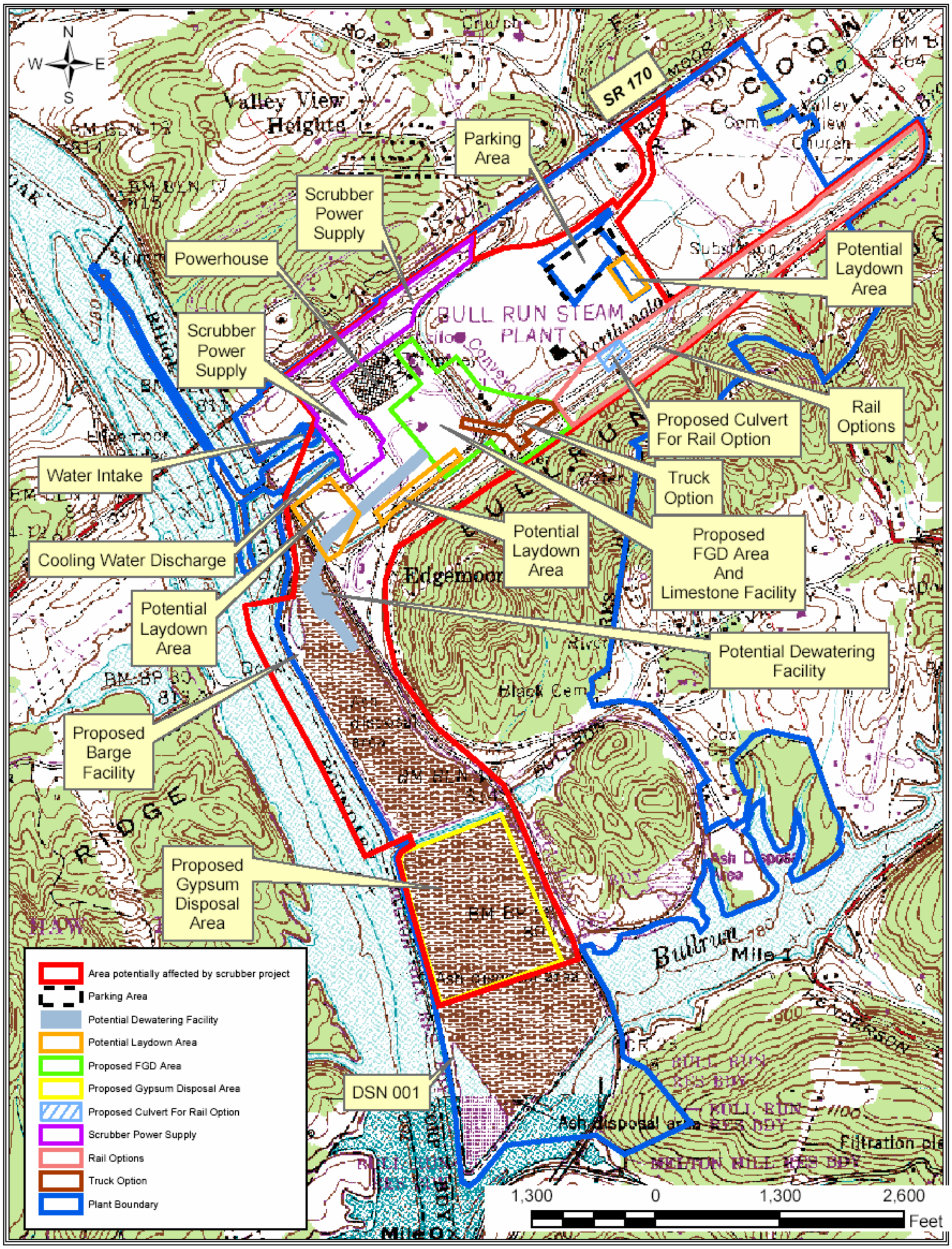


Figure 2-1. Generalized Footprint of Flue Gas Desulfurization Project at Bull Run Fossil Plant

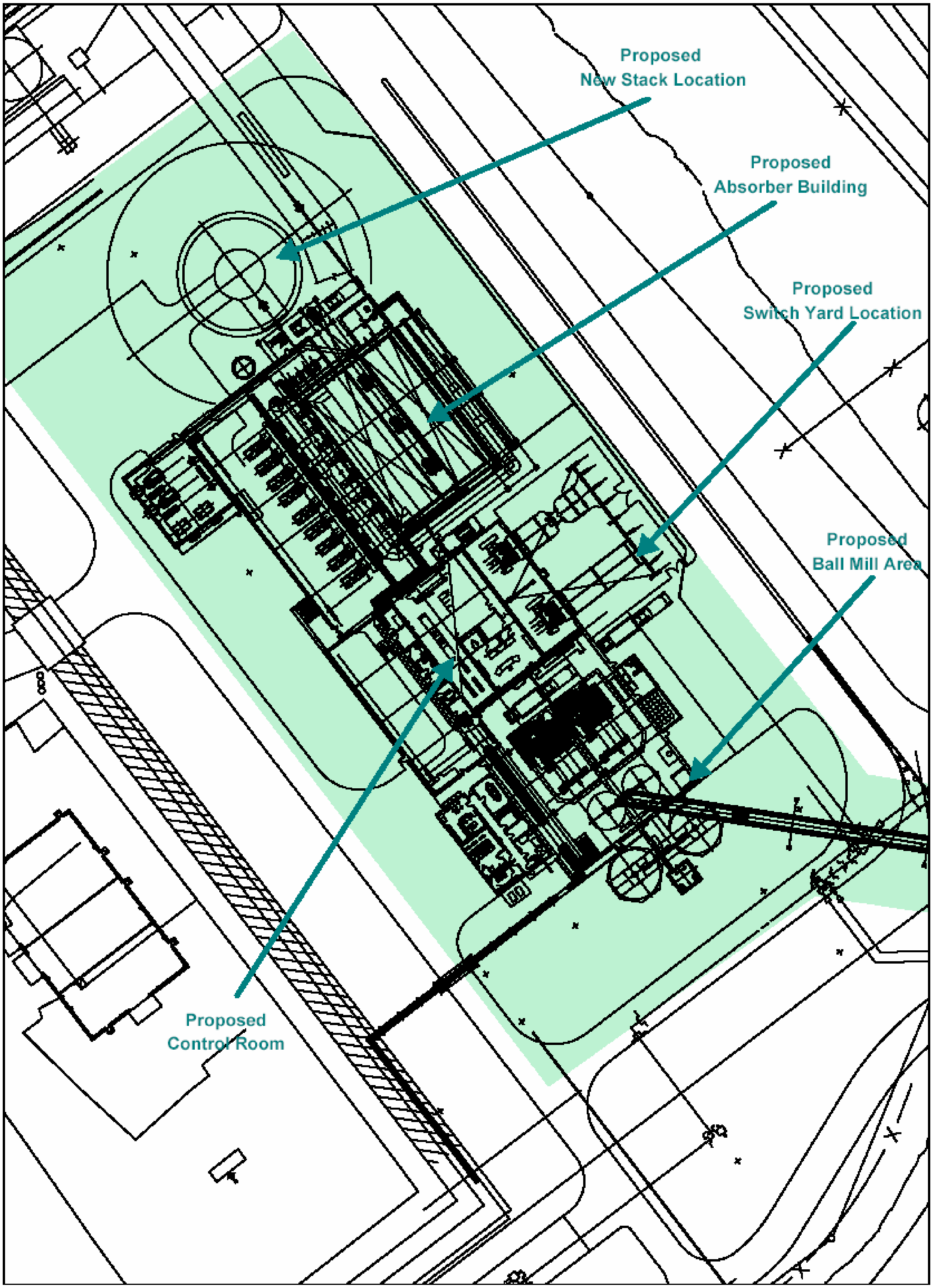


Figure 2-2a. General Plan for Bull Run Fossil Plant Scrubber Module

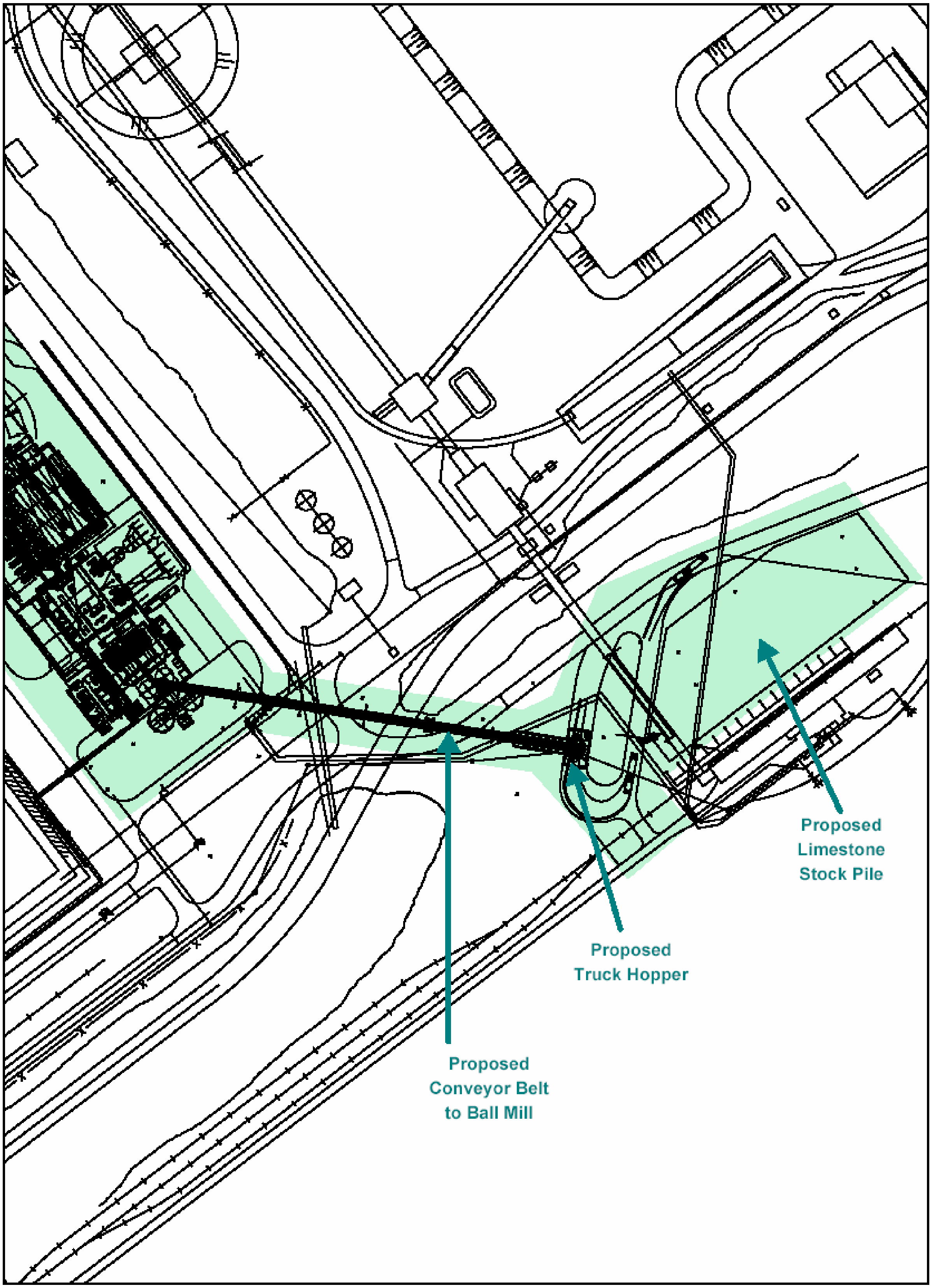


Figure 2-2b. General Arrangement of Bull Run Fossil Plant Flue Gas Desulfurization System (Option 1 - Delivery by Truck)

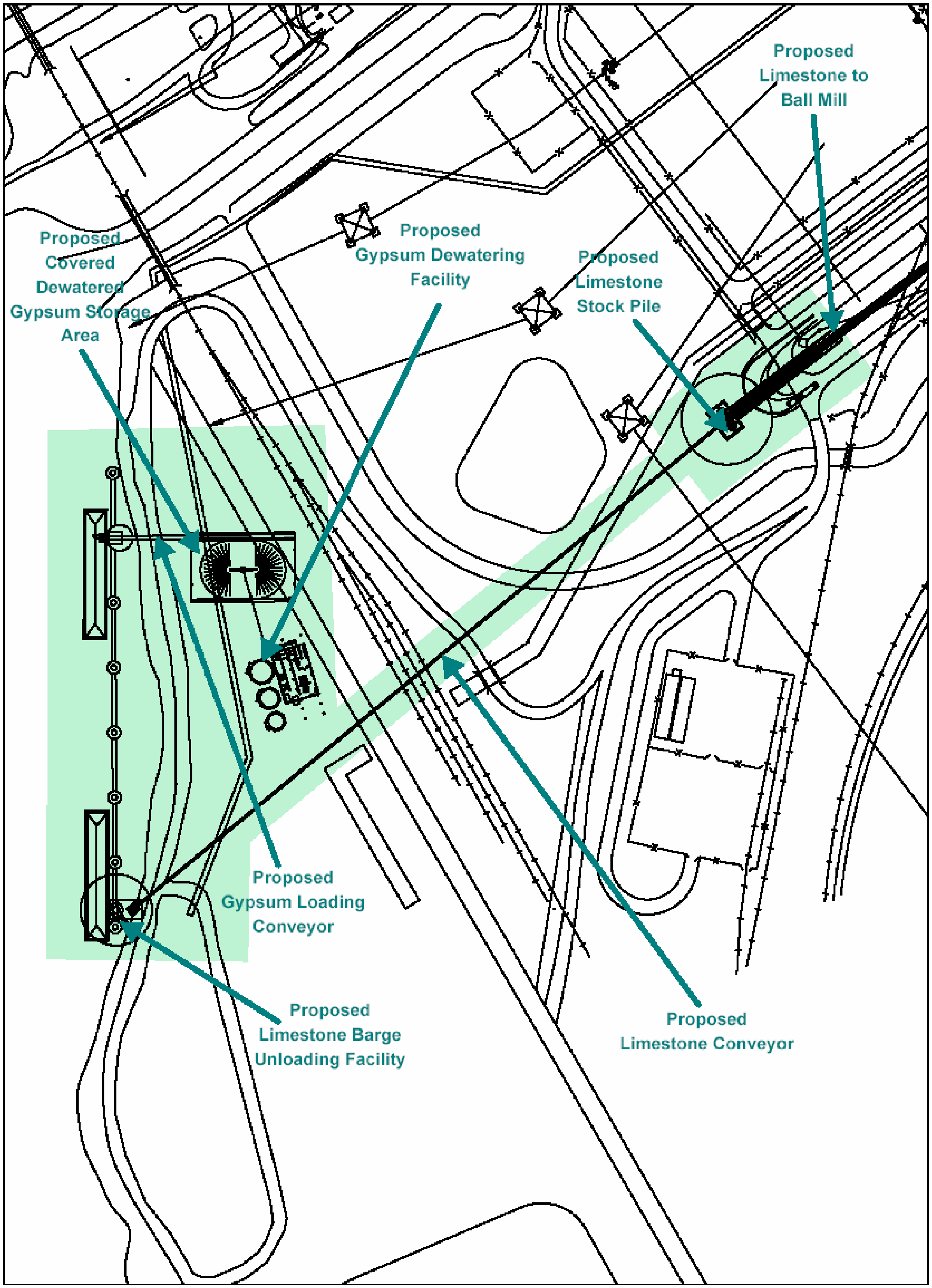


Figure 2-2c. Barge Facilities for Unloading Limestone and Loading Dewatered Gypsum (Option 2 - Delivery by Barge)

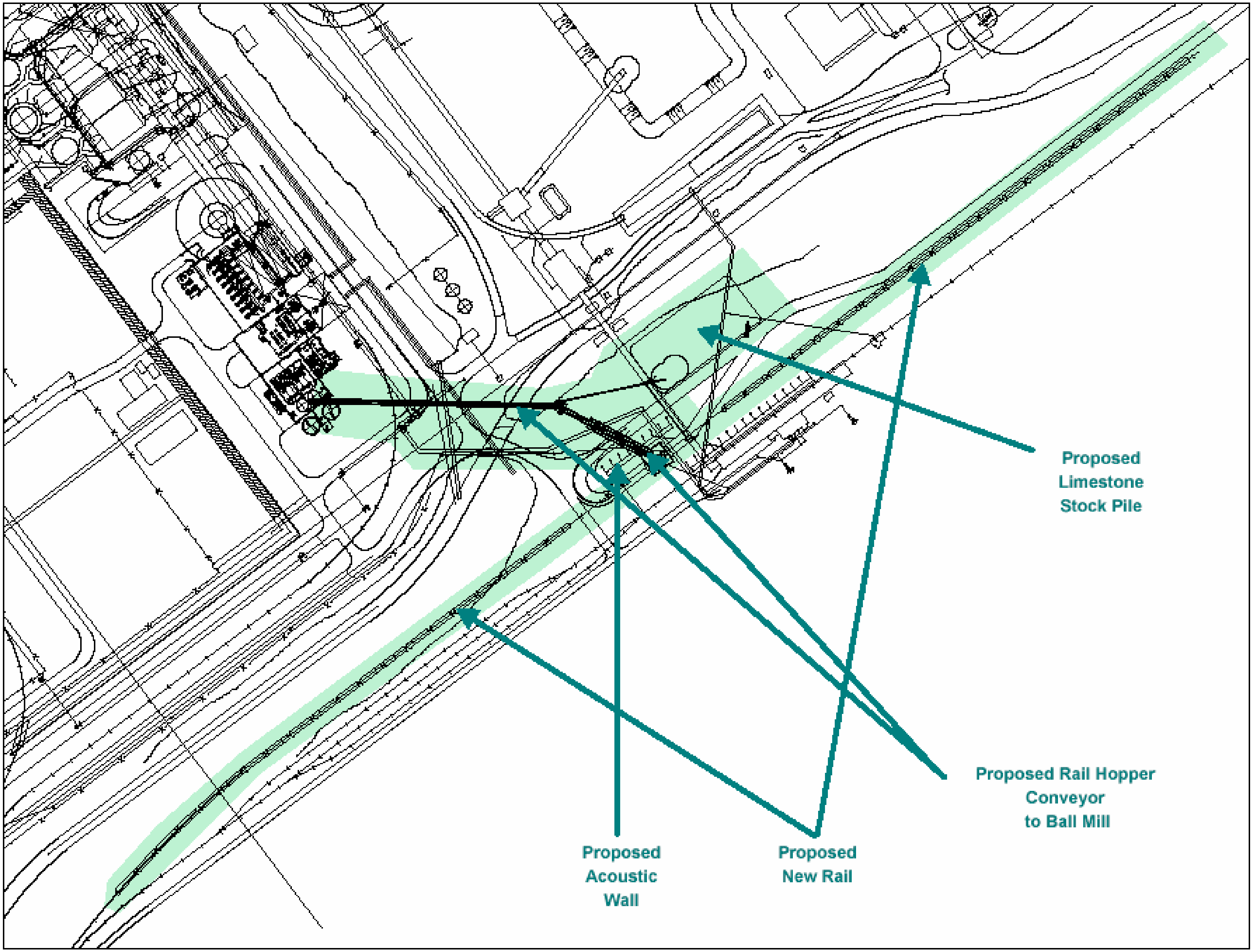


Figure 2-2d. General Arrangement of Bull Run Fossil Plant Flue Gas Desulfurization System, Close-up View (Option 3 - Delivery by Rail)

The absorber is larger than all other tanks used in connection with scrubbing. Limestone slurry occupies the lower portion of the absorber (sometimes called the reaction tank).

The oxidation air that is sparged or blown into the absorber liquid converts the dissolved calcium sulfite to calcium sulfate (gypsum). As the gypsum crystallizes, the heavier particles sink to the bottom of the tank where the concentration reaches about 15 to 30 percent; a bleed stream extracted to maintain equilibrium is pumped to the gypsum dewatering facility or to the gypsum wet stack. The absorber would be designed for the introduction of flue gas above the level of the slurry liquid where it would pass through one or more layers of slurry sprays. The treated flue gas would pass through mist eliminators, then to the stack. The stack height would be determined by Good Engineering Practice standards, regulatory requirements, computer dispersion modeling of ambient air impacts, and computer and/or physical flow modeling of the flue gas handling systems. The new proposed stack would have a fiber-reinforced plastic (FRP) liner that would be constructed on site. Modifications to existing fans or booster fans may be added to maintain the necessary flow through the absorber or maintain optimum flows elsewhere in the plant.

2.1.2. The Limestone Reagent Preparation System

This system consists of the equipment used to receive, store, and process the limestone, resulting in production of the limestone slurry used in scrubbing. Process water and crushed limestone are fed to a ball mill. A propylene glycol-based antifreeze solution may be added to the limestone and/or conveying system when moisture content and extremely cold conditions warrant. However, because of procedural and structural enhancements in the limestone handling system, not more than 50 gallons of antifreeze is expected to be used during any 24-hour period and not more than 2 days at a time. This use results in insignificant concentrations of propylene glycol entering the FGD and subsequently wastewater treatment system.

2.1.3. Limestone Purchase and Transport

Limestone is used to make the reagent used in wet LSFO scrubbers. Crushed limestone would be purchased from one or more quarries located in the vicinity and transported to the site by truck, barge, or rail. The quantity of limestone needed for scrubbing is contingent on the limestone purity, the reagent ratio (i.e., strength of limestone slurry solution), fuel heating value, and the amount of sulfur in the coal. Based on preliminary assumptions of fuel quality and TVA business plan coal-burn projections, estimates were prepared of the quantity of limestone needed. It is expected that the coal burned at BRF after installation of the scrubber would be from Central Appalachia and contain sulfur producing approximately 3.1 lb SO_2/mmBtu. However, it is possible that the coal sulfur content could be as high as the current SIP limit of 4.0 lb SO_2/mmBtu. This would mean that from 139,000 to 179,000 tons per year of limestone would be required.

Since TVA's purchase of limestone for BRF constitutes only a small fraction (less than 10 percent) of the total limestone production capacity of existing quarries in the vicinity and since multiple uses of limestone are present in the general area, the demand for this commodity is fungible, and TVA's purchase of limestone for BRF would likely not result in the opening of additional quarries. The exact source of limestone is not known since limestone purchases are competitively bid, and a request for proposals for limestone to supply the scrubber(s) would not be released until 2006 or 2007.

Information provided by the state of Tennessee Division of Geology (1983) indicates that 13 limestone quarries are operated in Anderson County or counties that border Anderson. However, not all quarries in the vicinity could provide limestone that would meet the minimum specifications needed for efficient scrubbing of SO_2. In general, the limestone eventually purchased for use in the BRF scrubber would need to contain at least 90 percent calcium carbonate (for reactivity), have relatively low silica content (for ease of grinding), have low dolomite content and low bitumen content (to control foaming in the scrubber and to provide an aesthetically pleasing gypsum product).

As noted above, the operating mode that would result in the greatest rate of limestone delivery to BRF would be the firing of coal with a sulfur content of 4.0 lb SO_2/mmBtu heat input, which is its current SIP limit for SO_2. Limestone delivered by truck would be transported only during the day on weekdays. Reflecting ten holidays per year, deliveries would be expected 251 days per year. Based on a limestone activity of 90 percent and a truck capacity of 24 tons, the delivery of 168,000 tons per year of limestone would require approximately 27 round trips per day, or about four round trips per hour over an 8-hour work shift. If the trucking option were chosen, the internal plant roads would be modified to accommodate the additional traffic. If either the barge or the rail option were chosen, limestone could be delivered any time and would be unloaded as needed.

2.1.4. Gypsum Slurry Dewatering, Transfer, Storage, and Disposal Systems

Gypsum is produced by the reaction of the limestone and SO_2 in the LSFO absorber. Because of the high quality and market value of the gypsum, facilities are being considered to process and transport (truck, barge, or rail) this material to markets. The gypsum stream would be pumped from the absorber through aboveground and buried pipes to a proposed facility for dewatering (Figure 2-1). Typically, this stream would flow at about 431 gallons per minute (gpm) and contain approximately 30 percent solids by weight. These solids would consist predominantly of gypsum crystals (>90 percent), but small amounts of unreacted limestone (less than [<] 3 percent), other inert material (6 percent), and fly ash (<0.5 percent) would be present. The wastewater from the dewatering facility would be routed to the ash pond complex for discharge through the permitted outfall, or it could be routed directly to the wet stack disposal area bypassing the dewatering facility.

The dewatering facility would consist of a mechanical dewatering system, staging area, and loading/unloading areas. After dewatering, the gypsum would be ready for transport to markets. Dewatered gypsum, which has a moisture content of about 3 to 6 percent by weight, not immediately marketed would be temporarily stacked in a specially designed storage building to await transport to purchasers or transported to the gypsum disposal area.

The amount of gypsum produced by LSFO scrubbing is dependent on the sulfur content and heating value of the coal, absorber efficiency, and the amount of coal fired.

The annual estimated gypsum production at BRF for the use of 3.1 lb SO_2/mmBtu coal is expected to be 220,000 cubic yards per year (for gypsum composed primarily of calcium sulfate). Figure 2-1 shows approximately the proposed location of the disposal area, which encompasses approximately 83 acres, that would be designed to accommodate nearly 2.6 million cubic yards of material. This would provide approximately 11.5 years of disposal capacity for the gypsum produced. Gypsum may be disposed of in the ash disposal area if space requirements dictate. Gypsum may also be removed from the disposal area and reprocessed if market needs arise. TVA plans to mitigate depletion of the gypsum disposal facility by aggressively marketing the gypsum.

2.1.5. Wastewater and Water Supply

The system requires both process and cooling water. For this EA, it is conservatively assumed that water demands could be as high as 3000 gpm, of that amount, 400 gpm would be for equipment cooling, 2500 gpm would be for process needs, and 100 gpm would be for miscellaneous use. At this rate for a capacity factor of 75 percent, the scrubber would use approximately 986 million gallons of raw water annually. A little less than half of this would be returned to the river; the remainder would be discharged to the atmosphere as water vapor. Of this, approximately 431 gpm would exit as scrubber effluent and ultimately be discharged through the bottom ash pond outfall.

The water supply needs of the BRF FGD project would be met by tapping into the existing plant intake system. No new intake pumps would be required for this project.

2.1.5.1. Power Supply

During construction, it is estimated that 1.0 to 1.5 megavolt amperes (MVA) are needed to supply equipment needs. BRF would continue to produce about the same amount of gross power as it does now; however, in operational mode, the new scrubber would be a power consumer. Electrical equipment would be designed to meet TVA codes and safety requirements. Where possible, use would be made of existing power supplies during construction. A new transformer yard (or switch yard) would be constructed to supply power to the scrubber equipment (Figure 2-2a). Connections into this yard would be provided from two sources: a transmission line connection to the existing plant 161-kilovolt (kV) switchyard at Bay 14 and a tap connection to the Bull Run–Lonsdale #2 161-kV Transmission Line located on the plant site. A new circuit breaker would be installed in existing Bay 14, and associated relays, control, and communication equipment would be installed in the plant switch house and the new transformer yard. Both transmission connections would utilize fiber-optic ground wire to provide communication and control circuits.

The tap point in the Bull Run–Lonsdale #2 161-kV Transmission Line is in front of the powerhouse and the new switch yard would be located on the plant site adjacent to the scrubber module. Two disconnect switches would be installed in the line, one on each side of the tap point. The tap point and the switches would be within the existing area now occupied by the transmission line. Associated relays and control and communication equipment would be installed in the new transformer yard and at the Lonsdale switch house.

All work for the transmission connection would be carried out within the footprint identified in Figure 2-1 for the new scrubber facilities, within the existing plant switchyard and switch house, on exiting line right-of-way or at the Lonsdale Substation.

Standard Best Management Practices (BMPs) would be used to limit erosion and storm water runoff during the construction period. An oil/water separator would be added to control surface water runoff from this area.

Figure 2-2a shows the location of the dedicated control room for the BRF scrubber. Underground cables would be constructed from the control room to the scrubber, limestone preparation building, the limestone conveyor and transfer points, and the switchgear room. The control system would be designed to meet all TVA specifications for materials, performance, and fire protection.

2.1.5.2. Equipment Laydown Areas

Probable equipment laydown areas are shown in Figure 2-1. Typically, laydown areas are nearby and not currently used for other plant functions but have been cleared and/or previously disturbed by industrial activities. The most likely areas to be used for laydown are west of the site proposed for the scrubber. Approximately 2 to 3 acres would be devoted to fabrication activities in these areas. These areas would utilize BMPs, such as gravel, hay bales, etc., to control surface water runoff.

2.1.6. Staffing and Workforce Management

The plot below (Figure 2-3) shows preliminary construction staffing projected for the scrubber project.

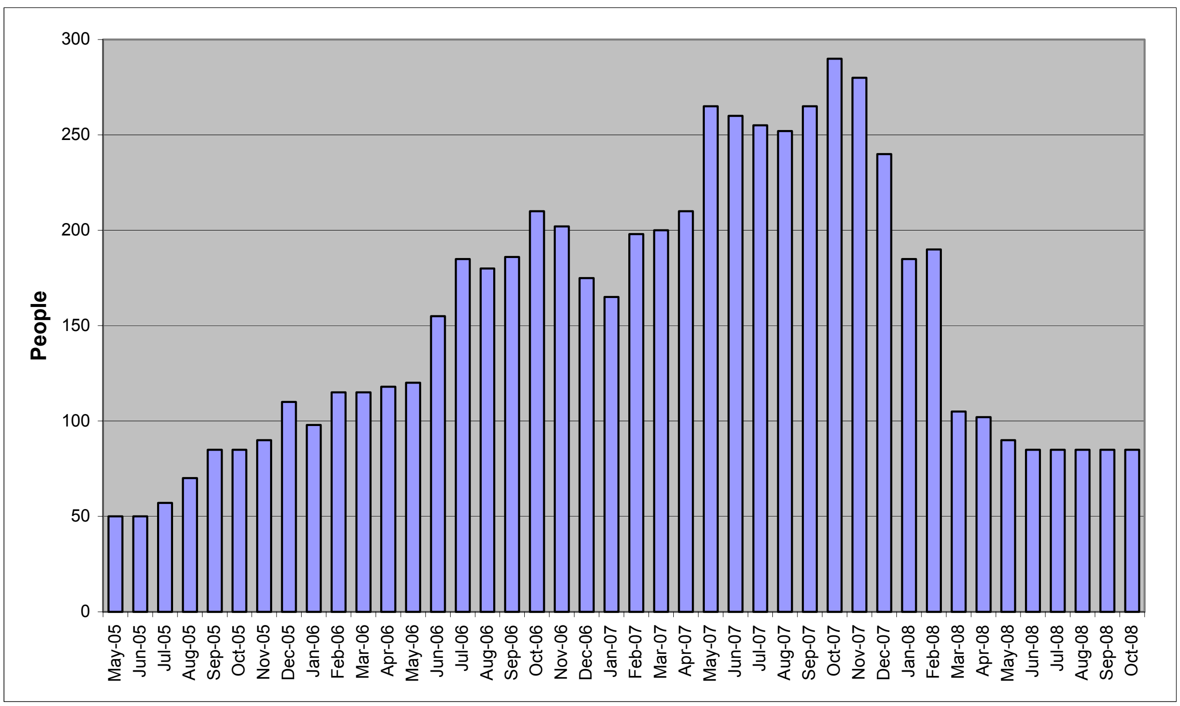


Figure 2-3. Bull Run Fossil Plant Construction Staffing

A conservative peak estimate for workers on site at any one time during the construction phase of the scrubber project is 500, which includes 300 for scrubber construction (all day shift), 160 permanent plant staff (day shift), and approximately 40 people working on site on small construction projects and/or unit outages. Scrubber construction would take place during daylight hours, except to overcome unacceptable schedule delays, and with the current preliminary schedule, it would take approximately 3.5 years to complete.

Plant permanent staffing is expected to increase by 25 to 30 people following startup of the scrubber. This would bring the total permanent daytime staff for operating the plant to as many as 190.

2.2. Alternatives to the Proposed Action

2.2.1. No Action Alternative

Under a No Action Alternative, no FGD or other system for SO_2 reduction from BRF would be installed. A No Action Alternative would not meet TVA's goal to reduce SO_2 emissions from BRF in order to help meet systemwide needs for reduction in SO_2 emissions. The No Action Alternative for BRF would likely result in the need to reduce SO_2 emissions from other TVA fossil plants or require purchase of additional pollution credit allowances.

2.2.2. Other Alternatives Not Considered in Detail

Other commercially available technologies were initially considered for application at BRF. Compatibility with existing operating and maintenance systems at the plant were the major considerations resulting in selection of wet limestone scrubbing as the proposed application at BRF. A sodium-based scrubber for a portion of the SO_2 emissions was briefly considered, but eliminated due to time constraints regarding ability to have the system in place by the time period in which it would be needed.

2.3. Comparison of Alternatives

The FGD system for BRF would be an addition to an expansive, heavy industrial facility having a significant property buffer, located in an area that has been heavily disturbed by previous plant developmental activities. No new facilities would be required to unload equipment transported to the site. The potential for on-site construction impacts to air quality, terrestrial ecology, wetlands, protected and sensitive species, land use, and visual aesthetics would be insignificant. This system would produce gypsum (a new byproduct for BRF) and result in a change in the effluent characteristics emanating from the byproduct handling facility. Operational impacts are primarily dependent upon the engineering features and safeguards included in the design of the FGD system and the environmental commitments. The potential for impacts due to operations are shown in Table 2-1. These features and safeguards listed in Table 2-1 would minimize the probability and extent of release of pollutants to the environment.

Table 2-1. Summary and Comparison of Alternatives By Resource Area		
Issue Area	**Impacts from No Action Alternative**	**Commitments for Impacts from Proposed Action Alternative**
Air Quality	• None	• Impacts to local and regional air quality would be minor but beneficial with the addition of the scrubber • Watering of roads to control fugitive emissions when necessary
Transportation	• None	• Insignificant impacts from truck, rail or barging of limestone with addition of a new intersection on SR 170
Visual Resources	• None	• Visible water plume; no commitments required
Noise	• None	• Insignificant with acoustic wall for rail limestone unloader
Surface Water and Wastewater	• None	• Insignificant with Aquatic Resource Alteration Permit, U.S. Army Corps of Engineers 404 permit, Modification of the National Pollutant Discharge Elimination System permit, Modification of the Strom Water Pollution Prevention Permit, and approval of Storm Water Construction Permit • Addition of an Oil/Water Separator for the new Switch Yard • Use of Portable Toilets by Construction Workforce • Wash down of Equipment without detergent • No off-site impacts with a commitment not to stack barges in the condenser cooling water discharge channel at the proposed barge facility
Groundwater Quality	• None	• Insignificant increases in contaminants of concern with or without liner in solid waste landfill
Coal Combustion Byproduct Generation, Handling, Disposal and Marketing	• None	• Quicker depletion of on-site coal combustion byproduct disposal capacity from the addition of a new gypsum waste stream; TVA proposes an aggressive gypsum marketing campaign

Table 2-1. Summary and Comparison of Alternatives By Resource Area

Issue Area	Impacts from No Action Alternative	Commitments for Impacts from Proposed Action Alternative
Floodplains	• None	• If the barge terminal were constructed, any dredged material would be stored above the 500-year flood elevation of 798 feet
Aquatic Ecology	• None	• None
Terrestrial Ecology	• None	• None
Protected and Sensitive Species	• None	• None
Wetlands	• None	• None
Managed Areas and Ecologically Significant Sites	• None	• None
Cultural Resources	• None	• None
Socioeconomics	• None	• None
Environmental Justice	• None	• None

2.4. Environmental Permits and Applicable Regulations

- Implementation of the proposed action would result in the need to modify the National Pollutant Discharge Elimination System (NPDES) Permit TN0005410.
- Modifications to the current ash disposal area would be needed to incorporate disposal of gypsum not marketed.
- Coverage under the Construction Storm Water Permit would be obtained from the Tennessee Department of Environment and Conservation (TDEC) to ensure all construction-related activities comply with applicable regulatory requirements.
- Hydrostatic test discharges would be handled in accordance with the BMP developed in accordance with the NPDES Permit.
- Air construction notification would be required to TDEC. A minor source construction permit may be required for the limestone handling system. No other permits would be required by TDEC due to the pollution prevention nature of this project.
- Aquatic Resource Alteration Permits (ARAPs) would be required for the addition of proposed new culverts, retaining wall, and barging facility.
- A United States Army Corps of Engineers (USACE) 404 Permit for affected water resource areas in the Clinch River, Worthington Branch, and the unnamed tributary to the Clinch River would be necessary.

CHAPTER 3

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. Air Resources

3.1.1. Affected Environment

Air quality is an environmental resource value that is considered important to most people. Through its passage of the Clean Air Act, Congress has mandated the protection and enhancement of our nation's air quality resources. NAAQS for the following criteria pollutants have been set to protect the public health and welfare:

- sulfur dioxide (SO_2)
- ozone (O_3)
- nitrogen dioxide (NO_2)
- particulate matter whose particles are less than or equal to (<=) 10 micrometers (PM_{10})
- particulate matter whose particles are <= 2.5 micrometers ($PM_{2.5}$)
- carbon monoxide (CO)
- lead (Pb)

A listing of the NAAQS is given in Table 3-1.

National standards, other than annual standards, are not to be exceeded more than once per year (except where noted). The results of ambient air monitoring near BRF are shown in Table 3-2.

Table 3-2 gives the results of ambient air quality monitoring of criteria pollutants that are considered representative of the BRF site. All areas in the vicinity of the site are currently in attainment for PM_{10}, NO_2, CO, SO_2, and Pb standards.

Regionally, air quality is generally good. The air quality in the vicinity of BRF is also generally good; the area complies with all ambient air quality standards, except for the new 8-hour ozone and fine particulate matter ($PM_{2.5}$) standards. USEPA recently included Anderson County as part of the Knoxville nonattainment area for O_3 and fine particulate matter ($PM_{2.5}$) based on USEPA's criteria for identifying nonattainment areas. The new 8-hour ozone and $PM_{2.5}$ standards are more stringent than the old ozone and particulate standards. Many areas of the country are having difficulty attaining the new 8-hour ozone and $PM_{2.5}$ standards.

Table 3-1. National Ambient Air Quality Standards

Pollutant	Primary[a]	Secondary[b]
Sulfur Dioxide	0.14 parts per million (ppm) (365 micrograms per cubic meter [μg/m^3]) maximum 24-hour concentration not to be exceeded more than once per year 0.03 ppm (80 μg/m^3) annual arithmetic mean	0.5 ppm (1,300 μg/m^3) maximum 3-hour concentration not to be exceeded more than once per year
Ozone (New)	0.08 ppm based on the average of the fourth-highest daily maximum 8-hour concentration during each ozone season (currently May 1 – September 30) for each of three consecutive years	Same as primary standard
Nitrogen Dioxide	0.053 ppm (100 μg/m^3) annual arithmetic mean	Same as primary standard
Carbon Monoxide	35 ppm (40 milligrams per cubic meter [mg/m^3]) maximum 1-hour concentration not to be exceeded more than once per year 9 ppm (10 mg/m^3) maximum 8-hour average concentration not to be exceeded more than once per year	None
$PM_{2.5}$ (New Standard)	65 μg/m^3 maximum 24-hour average concentration with an expected exceedance of no more than one per year based upon a 3-year average 15 μg/m^3 annual arithmetic mean	Same as primary standard
PM_{10}	150 μg/m^3 maximum 24-hour average concentration with an expected exceedance of no more than one per year based upon a 3-year average 50 μg/m^3 annual arithmetic mean	Same as primary standard
Lead	1.5 μg/m^3 maximum quarterly arithmetic mean	Same as primary standard

Source: 40 CFR, Part 50, as currently amended
a - Standards set to protect public health
b - Standards set to protect public welfare

Table 3-2. Ambient Concentrations of Criteria Air Pollutants Near Bull Run Fossil Plant Compared With Air Quality Standards

Pollutant	Level of Standard (ppm)[a]	1-Year Maximum or Mean Concentration (ppm)[a]	1-Year Maximum or Mean Percent of Standard
Ozone (New Standard)[b]	4th Highest 8-hour average (0.08)	0.078[c]	98
Sulfur Dioxide	Maximum 3-hour average (0.5)	0.106[c]	21
	Maximum 24-hour average (0.14)	0.027[c]	19
	Annual mean (0.030)	0.0028[c]	9
Nitrogen Dioxide	Annual mean (0.053)	0.0118[d]	22
Carbon Monoxide	Maximum 1-hour average (35)	1.0[e]	3
	Maximum 8-hour average (9)	1.0[e]	11
PM_{10} (Old Standard)	(µg/m^3)	(µg/m^3)	
	Maximum 24-hour average (150)	148[f]	99
	Annual mean (50)	40.3[f]	81
$PM_{2.5}$ (New Standard)	(µg/m^3)	(µg/m^3)	
	Maximum 24-hour average (65)	47.2[g]	73
	Annual average (15)	16.0[g]	107
Lead	(µg/m^3)	(µg/m^3)	
	Quarterly mean (1.5)	0.15[h]	10

a - ppm unless otherwise noted
b - Fourth-highest concentration must be 0.085 ppm to be considered above the level of the standard (0.08 ppm)
c - O_3 and SO_2 values for Anderson County, Tennessee, 2003.
d - NO_2 values for McMinn County, Tennessee, 2003
e - CO values for Meigs County, Tennessee, 2003
f - PM_{10} values for Union County, Tennessee, 2003
g - $PM_{2.5}$ values for Knox County, Tennessee, 2003
h - Lead value for Sullivan County, Tennessee, 2003

3.1.2. Environmental Consequences

Under the No Action Alternative, air pollutant emissions would be unchanged. Consequently, air quality would not be improved.

Construction Impacts

The proposal under consideration would have associated transient air pollutant emissions during the construction phase of the project. Construction-related air quality impacts are primarily related to land clearing, site preparation, and the operation of internal combustion engines.

Land clearing, site preparation, and vehicular traffic over unpaved roads and the construction site result in the emission of fugitive dust PM during site preparation and active construction periods. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the construction site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary. If necessary, emissions from open construction areas and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 75 percent. The project would comply with Tennessee regulations applicable to fugitive emissions.

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, construction equipment, etc.) would generate local emissions of PM, NOx, CO, volatile organic compounds, and SO_2 during the site preparation and construction period. The total amount of these emissions would be small and would result in minimal off-site impacts.

Styrene will be used in the fabrication of the FRP stack liner constructed at BRF. Modeling results show that on-site and off-site ground-level concentrations of styrene during the fabrication process would be well below the 1 part per million (ppm) odor threshold. Also, dispersion modeling was done to determine the impacts from a possible accidental release of the entire contents of a liquid styrene tank. In this release scenario, the off-site impacts were below the Occupational Safety and Health Administration and American Conference of Governmental Industrial Hygienists time-weighted average and short-term exposure limits. Based on these modeling results, it is unlikely that an accidental release would pose a threat to the health of people off site.

Air quality impacts from all of these construction activities would be temporary and dependent on both man-made factors (e.g., intensity of activity, control measures, etc.) and natural factors (e.g., wind speed, wind direction, soil moisture, etc.). However, even under unusually adverse conditions, these emissions would have, at most, a minor, transient impact on off-site air quality and be well below the applicable ambient air quality standard. Overall, the air quality impact of construction-related activities for the project would not be significant.

Operational Impacts

An air quality analysis was performed in accordance with the USEPA's Guidelines on Air Quality Models (USEPA, 2001a). The focus of the analysis was to determine the air quality impacts of SO_2 emissions on the area surrounding BRF before and after installation of FGD.

Refined modeling was performed using the Industrial Source Complex 3 (ISCST3) model assuming maximum emissions. These modeling runs were made using detailed receptor sets and representative hourly meteorology. The model was run assuming a 100 percent operational load. Descriptions of the dispersion models, sources, data requirements, and modeling results are presented in the following sections.

The modeling was performed assuming that a new stack would be constructed as part of the FGD project. As a conservative measure, dispersion modeling was performed assuming that the new stack height would conform to USEPA's definition of Good Engineering Practice.

Air Quality Dispersion Model - The ISCST3 model, a USEPA-approved model, was used to estimate air pollutant concentrations surrounding BRF (USEPA, 1995). A description of ISCST3 is contained in Volume II of the user's guide. The model is based on the straight-line, steady-state Gaussian plume equation, which is used with some modifications to model simple point source emissions.

Sources - The physical dimensions and flue gas parameters of the stack used in the modeled case are presented in Table 3-3. The emission rates used in the modeled case are presented in Table 3-4 and represent continuous operation during the year. The emissions and exhaust flows presented in these tables reflect maximum operating conditions. This approach ensured that the modeling produced conservative estimates of ambient impacts. The modeling results are presented in Table 3-5.

Table 3-3. Stack Location, Physical Dimensions, and Flue Gas Parameters

Unit Number	Easting (km)	Northing (km)	Stack Base Elevation (ft-msl)	Stack Height (m)	Stack Diameter (m)	Stack Exit Velocity (m/s)	Stack Temperature (K)
1	756.369	3989.757	806	150.1	10.13	15.24	325.2

km = kilometer
ft-msl = feet mean sea level
m = meter
m/s = meters per second
K = Kelvin

Table 3-4. Sulfur Dioxide Emissions Used in Modeling

Unit	Emission Rate (lb/mmBtu)	Emission Rate (g/s)
BRF Unit 1	0.16	173

Note: Emissions are based on coal with 3.1 lb SO_2/mmBtu and 95 percent SO_2 removal.
g/s = grams per second

Receptors - The refined ISCST3 modeling was performed with receptors extracted from the United States Geological Survey (USGS) Digital Elevation Model database. The receptors covered a 15.6-kilometer (km) by 18.9-km area centered on the site. Receptors were spaced approximately 155 meter and 185 meter in the east-west and north-south directions, respectively, for a total of 10,202 receptors.

Meteorology - ISCST3 dispersion modeling was performed using 6 years (1984-87, 1990-91) of meteorological data based on hourly National Weather Service surface meteorological measurements at Knoxville and twice-daily upper air measurements from Nashville, Tennessee. Hourly mixing heights were determined from Nashville, Tennessee, morning and afternoon mixing depths.

Air Quality Modeling Results - Modeling was performed to evaluate the impact of the BRF FGD project on air quality in the surrounding area. The modeling results also provide a comparison of impacts relative to established air quality metrics. In particular, pollutant-specific NAAQS are the concentration levels established by USEPA to protect public health for various averaging times.

Table 3-5 summarizes the modeling results of air impacts. The highest concentration (in µg/m^3) in the vicinity of the plant is presented for the annual averaging period and the highest-second-highest is presented for both the 24-hour and 3-hour averaging periods (to enable comparison with air quality standards).

Table 3-5. Sulfur Dioxide Modeling Results

Averaging Period	NAAQS (µg/m^3)	Concentrations (µg/m^3)
Annual	80	1.7
24-hour	365	15.5
3-hour	1300	64.4

Concentrations of other pollutants for which NAAQS exist are not expected to be appreciably changed by the addition of the scrubber. When the SCR is operating (that has already been constructed), mercury can be converted to a water-soluble compound and be removed in the scrubber at a rate of 80 to 90 percent for the type of coal expected to be burned at BRF (Moore, 2003). Without an SCR, the removal of mercury in wet limestone scrubbers is typically 55 percent.

There may be periods when the absorber is bypassed due to malfunctions or maintenance requirements. In that event, the flue gas would be ducted to the existing stack. These periods should be brief and the plant will operate in compliance with the current 4.0 lb SO_2 /mmBtu emission limitation at all times during any absorber bypass. In the event an extended bypass is necessary the plant will return to burning coal(s) with lower sulfur content.

Some utilities with coal-fired power generating facilities that have installed SCR controls and limestone scrubbers in series to control NOx and SO_2 emissions have experienced an increase in opacity of the exhaust plume exiting the stack. For facilities that had been operating at low opacity prior to the installation of the SCR and scrubber, the increase in opacity after installation of these controls was a surprising result. TVA, along with the Electric Power Research Institute (EPRI) and other utilities, is evaluating this problem and developing methods and technology to address this issue. TVA will evaluate available methods and technology and, if it is determined to be necessary, will install the most appropriate technology to maintain opacity at acceptable levels.

The operation of the limestone handling facility associated with the scrubber would result in minor emissions of particulate, would be subject to Tennessee Division of Air Pollution Control emission requirements, and would not have a significant impact on local air quality. Most of the particulate emissions would result from the hauling of limestone by truck over paved and unpaved roads. These particulate emissions from paved and unpaved roads could be mitigated by spraying water on the roadways as needed to reduce fugitive dust emissions by as much as 75 percent.

Cumulative Regional Impacts

The installation of FGD at BRF Unit 1 is part of an SO_2 emissions reduction effort that contemplates FGD installation on several of TVA's fossil plants. Construction of an FGD system at PAF Unit 3 is already underway. The other units being considered for installation of FGD are COF Unit 5 and KIF Units 1-9. The proposed action (installation of FGD on BRF Unit 1) is part of a TVA systemwide emissions reduction effort that is expected to benefit overall regional air quality.

Cumulative impacts on air quality in the Southeast due to changes in future emissions were evaluated by the Southern Appalachian Mountains Initiative (SAMI) by performing extensive photochemical and regional haze modeling. A primary conclusion from SAMI's work was that reduction of emissions within a state would provide the most improvement to the air quality within the same or adjacent states. Although SAMI did not model individual sources, the conclusions of the study can be extended to a collection of sources to infer that the primary air quality benefit of SO_2 emissions reductions will be within the states where they are located and in the region adjacent to those states. Thus, although SO_2 emissions reductions due to installation of FGD at BRF, COF, KIF, and PAF are expected to lead to improvement in overall regional air quality, the most improvement would be within the TVA region.

3.2. Transportation

3.2.1. Affected Environment

Highway, railway, and waterway modes of transportation serve BRF. The plant, located in Anderson County, Tennessee, lies approximately 5 miles east of downtown Oak Ridge and 13 miles west of Knoxville. Most lands nearby are DOE reservation properties for the Oak Ridge facilities, but residential and recreational areas are in close proximity.

3.2.1.1. Highways and Roads

The plant adjoins SR 170 (Edgemoor Road) between SR 162 (Pellissippi Parkway) and US 25 (Clinton Highway). SR 162 and US 25 are principal four-lane divided highways with wide shoulders traversing a gently rolling suburban area in an east-west direction, while SR 170 is a similar style, two-lane road. These routes are the probable truck routes used from any of the prospective limestone quarries. Therefore, they are the primary routes studied in the transportation portion of this assessment. The following table shows the 2004 Average Annual Daily Traffic (AADT) counts provided by the Tennessee Department of Transportation. Figure 3-1 details the routes and traffic for the potential truck delivery option (Option 1).

Table 3-6. Primary Routes Studied With Average Annual Daily Traffic Counts Shown

Route	AADT
US 25	16,740
SR 162	42,790
SR 170	17,620

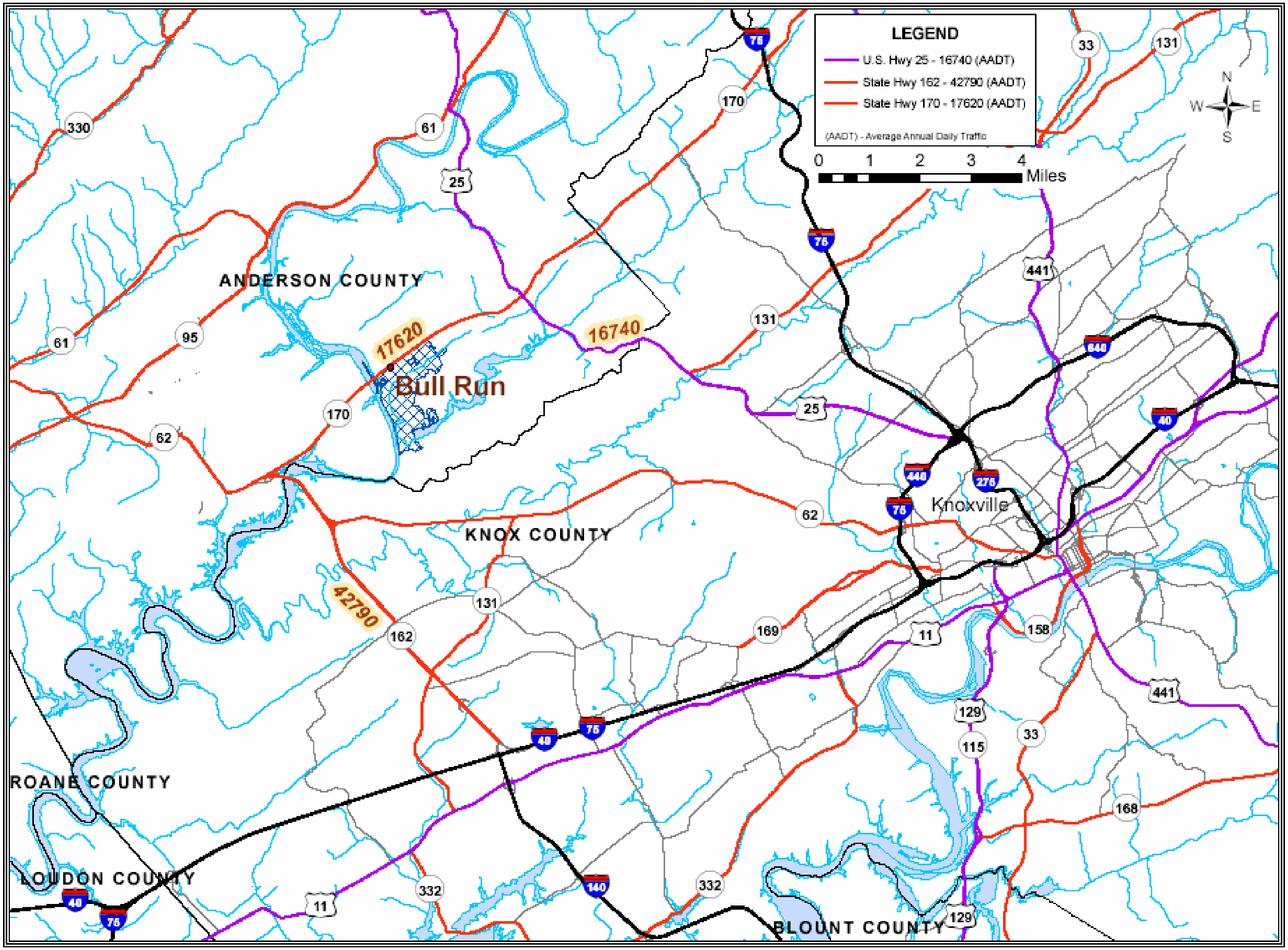


Figure 3-1. Primary Routes Studied With Average Annual Daily Traffic Counts Shown

With Option 1, truck-receiving hoppers and transfer conveyors would be required at the BRF facility. The location being evaluated for this equipment is south of the drainage pond for the coal yard as depicted in Figure 2-2b.

3.2.1.2. River Transport

The BRF plant site is located on the east side of TVA's Melton Hill Reservoir, CRM 48. The plant is between the Melton Hill Dam (downstream) and Norris Dam (upstream), located at CRMs 23 and 73, respectively. Norris Dam has no locks, due to this section of the Clinch River being considered unnavigable. Melton Hill Dam does have a lock with a length of 400 feet and a width of 75 feet. The existing amount of commercial traffic in this portion of the Clinch River is minimal. The locks and channels are more than adequate for handling barge traffic, and the lock has operated at an average of just over 7 percent of its utilization capacity for the last 3 years. Table 3-7 illustrates lock and traffic data obtained from the USACE.

Due to the location of the prospective limestone quarries, it is unlikely that barge transport (Option 2) is a viable option to supply the BRF scrubber with limestone. There are currently no barge or materials handling facilities at BRF; therefore, this option requires that mooring cells, receiving hoppers, conveyors, and transfer stations be constructed at BRF between the Clinch River and the scrubber. See Figure 2-2c for details.

Table 3-7. Lock and Traffic Data Obtained From the U.S. Army Corps of Engineers

Melton Hill Dam - Clinch River Traffic Data			
Analysis Year	**2004***	**2003**	**2002**
Recreational Vessels	52	23	83
Recreational Lockages	37	21	65
Commercial Vessels	2	4	7
Commercial Lockages	2	4	7
Light Boats	0	3	2
Light Boat Lockages	0	3	2
Barges	9 Loaded 3 Empty	13 Loaded 11 Empty	46 Loaded 45 Empty
Annual Tonnage	1,870	3,810	19,336
Lock Utilization	9 percent	4 percent	9 percent
Average Delay	2.09 hours	5.96 hours	1.09 hours

*2004 data are through 10/31/2004 (Tim Wright, U.S. Army Corps of Engineers, personal communication, 2004).

3.2.1.3. Railroads

CSX Transportation, Inc., operates a main east-west rail line that serves the plant. TVA has two spurs, approximately 2 linear miles total, that connect the CSX mainline to the BRF site. Currently all of the coal burned at BRF arrives by rail. Table 3-8 contains data concerning the current coal deliveries to BRF.

Table 3-8. Current Coal Deliveries to Bull Run Fossil Plant

Loaded Rail Car Units per Day	Loaded Rail Cars per Unit	Tons of Coal per Unit	Tons of Coal Annually
1	90	10,000	2,200,000

A limestone-receiving hopper, transfer station, and transfer conveyors would be constructed and used with the existing on-site rail spur at the BRF site if Option 3 were chosen. These facilities would be located south of the existing drainage pond for the coal yard. See Figure 2-2d for details.

3.2.2. Environmental Consequences

For the No Action Alternative (no scrubber facility would be added at BRF), none of the transportation modes listed above would be affected. By adding a scrubber facility, there would be additional road, waterway, and/or rail traffic generated during the construction of the facility, the deliveries of limestone to the plant, and the removal of gypsum from the plant. This analysis addressed the impacts for all of the modes listed and assumed a conservative estimate of the transportation of 168,000 tons of limestone annually.

3.2.2.1. Highways and Roads

By building a scrubber facility at BRF, there would be minor impacts to the road systems both during the construction and operation periods. An additional 300 workers would be on site during construction. Assuming an average of 1.6 persons per vehicle with a trip to and from the plant each day, 375 trips would be generated to accommodate the workers. Once construction is completed, there would be an average of 27 trucks per day delivering limestone and possibly 63 additional trucks removing gypsum during normal working hours daily. However, due to weather and other unforeseen conditions, there could be as many as 30-35 trucks per day delivering limestone. Since it is highly unlikely that all of the marketed gypsum would be delivered by trucks, a more realistic number for marketing by trucks would be 10-15 additional trucks per day. The number of trucks used assumes there are no haul backs. Ideally, trucks would deliver limestone and leave with a load of gypsum. This would decrease the number of trucks by approximately 40 percent. The analyses assume that 75 percent of the additional traffic would use SR 162 to arrive at SR 170 while 25 percent would use US 25. TVA would construct a new intersection at the plant to accommodate this new traffic to the BRF facility. Some minor delay may be experienced at the intersection of Edgemoor Road and Melton Lake Drive during the peak of the construction period. The people primarily experiencing this delay, which could be tolerated for the duration of construction, would be the construction workers and delivery trucks.

The *Highway Capacity Manual* (Transportation Research Board, 2000) outlines methods for evaluating the operational conditions within a traffic stream. These methods take into account, among other inputs, average highway speed, lane widths, shoulder widths, and alignment. These methods define six levels of service (LOS) using the letters A through F. LOS A represents the best service, generally operational free flow with very low delay. LOS F represents the worst-operating conditions, signifying a buildup of queues and delays.

In the long term, operation of the scrubbers would not degrade the LOS. The potential increase in traffic for both the construction and operational phases of the scrubber is insignificant. The roads in the area are fully capable of absorbing the additional traffic with no problems; the LOS is unchanged based on our conclusions. The following table has the data from the LOS analyses.

Table 3-9. Data from Level of Service Analyses

Route	Condition	AADT	Flow Rates, v_P	Level of Service
US 25	Existing	16,740	596 pc/hr/ln*	A
	Future	16,985	605 pc/hr/ln	A
SR 162	Existing	42,790	1,523 pc/hr/ln	D
	Future	43,254	1,540 pc/hr/ln	D
SR 170	Existing	17,620	2,433 pc/hr	E
	Future	18,056	2,495 pc/hr	E

V_p = passenger car equivalent flow rate/15-minute peak
*passenger cars/hour/lane

The *Highway Capacity Manual* (Transportation Research Board, 1994) outlines methods for evaluating the operational conditions at intersections. These methods take into account the volumes making various turning movements, conflicting flow volumes, and lane capacities, to name a few. These methods define the same six levels of service, LOS A through LOS F.

The addition of the new intersection would not have a significant impact on the traffic traveling on Edgemoor Road. The new intersection would have an average of 0.4-second total delay and an LOS A designation and consist of new turning lane with acceleration and deceleration lanes as depicted in Figure 3-2.

3.2.2.2. River Transport

The shipment of limestone and removal of gypsum would increase river traffic. The BRF site is between the Melton Hill Dam (downstream) and Norris Dam (upstream). Due to the lack of locks at Norris Dam, all additional river traffic would occur downstream of the BRF site through the Melton Hill Lock. As described in Sections 3-3, 3-4, 3-5, 3-6, 3-7, and 3-8, this option would also require the construction of a new barge loading and unloading facility at BRF.

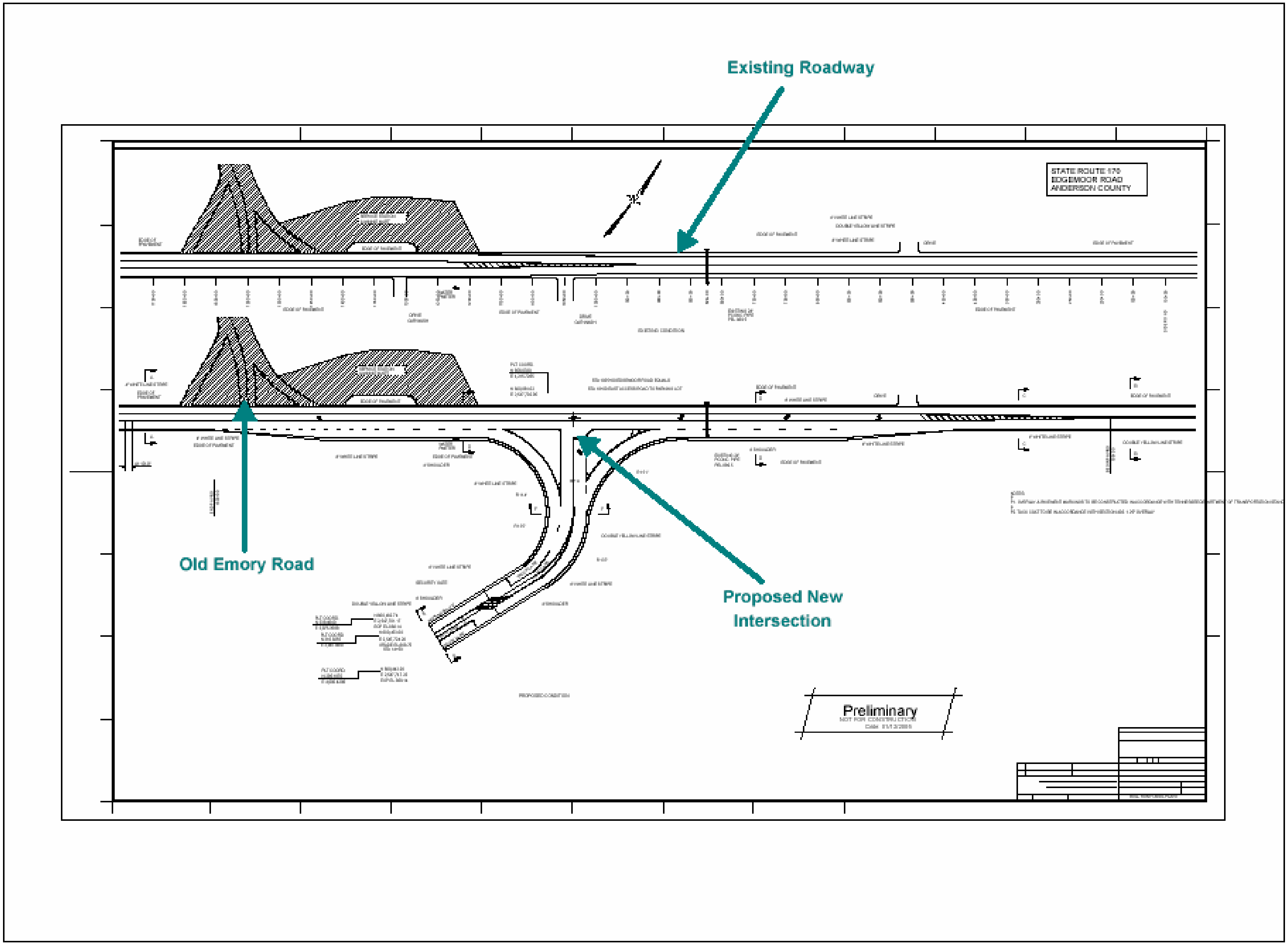


Figure 3-2. Proposed SR 170 Intersection

The limestone barges would most likely arrive in dedicated tows as opposed to mixed tows. This direct service would imply that a three-barge tow would travel the Clinch River once per week one-way. This would add 104 tows per year, including return trips with empty barges, and give an annual tonnage of 168,000 tons. This would increase the annual commercial lockages by 2.7 percent, bringing total usage to 11.7 percent of the lock's capacity.

The river transport option of removing gypsum for marketing or disposal would net similar results as the receiving of limestone. Gypsum removal would increase annual commercial lockages by another 2.7 percent, producing a total usage of 14.4 percent of the lock's capacity.

The possible addition to barge traffic would have a minor impact on the capacity of the waterway system upstream of the Melton Hill Lock. Barge traffic would increase, but not to the point that any significant congestion effects would be experienced. In addition, the truck traffic added with this option does not alter the results of the highways and roads LOS analyses.

3.2.2.3. Railroads

The shipment of limestone and removal of gypsum would increase railway traffic insignificantly. There is a predicted increase of 16.3 percent of hauled material or 104 one-way loaded rail car units annually to the existing network. The use of haul backs is not an option for rail delivery. The following table contains the predicted rail data.

Table 3-10. Predicted Rail Data

	Coal Received	Limestone Received	Gypsum Shipped
Loaded Rail Car Units per Week	5	1	1
Loaded Rail Cars per Unit	90	30	45
Tons of Material per Rail Car Unit	10,000	3,231	4,920
Tons of Material Annually	2,600,000	168,012	255,840

With an increase in rail traffic, potential for accidents or blockages at any at-grade intersection also increases. However, the main highway routes evaluated in this study (SR 162 and SR 170) do not have any at-grade crossings in the areas that were studied. The possibility of derailments is increased due to the additional rail traffic. Derailments can occur due to inadequate maintenance, objects on the track, mechanical failure, or sabotage. Derailments are generally not as likely with rail cars traveling at low speeds, which would be the case here. No delays should be experienced due to the possibility of increased rail traffic.

3.3. Visual Resources

3.3.1. Affected Environment

Visual resources are evaluated based on existing landscape character, distances of available views, sensitivity of viewing points, human perceptions of landscape beauty/sense of place (scenic attractiveness), and the degree of visual unity and wholeness of the natural landscape in the course of human alteration (scenic integrity).

The proposed project area is located at BRF in Anderson County, Tennessee, along Edgemoor Road (SR 170) on the eastern bank of the Clinch River at CRM 48. The topography ranges from steep along the river edges to gently sloping within BRF. Land use is predominately industrial with dispersed areas of open pasture and woodlands. Potential user groups that would likely have direct views of the proposed project area include motorists traveling Edgemoor Road, recreational users along the Clinch River, employees and visitors to the plant, and residents outside the proposed project area.

Views of the project areas are currently those of an active industrial setting. For motorists, views of the proposed project area from Edgemoor Road include broadly horizontal buildings, parking areas, the switchyard on the west side of BRF, and a variety of open spaces and woodlands. Predominate focal points include the live coal silo and 800-foot smokestack, which can be seen in the foreground (0 to 0.25 mile) and the middleground (0.25 mile to 4 miles). Recreational users along the Clinch River have oblique views of the project area from the west, particularly of taller buildings and the live coal silo and smokestack. Views of the proposed barge facility would be in the foreground along the Clinch River. Employees and visitors to the plant site view numerous industrial features within the project area; these features include storage and laydown areas, associated fencing, railway beds and tracks, and myriad temporary and permanent buildings of various heights. Residents outside the project area would have views in the middleground and background (4 miles to the horizon) from surrounding ridges. These views are influenced by seasonal variations and atmospheric conditions.

Scenic attractiveness of the proposed project area within BRF is minimal, and scenic integrity ranges from low to very low. Scenic attractiveness along the Clinch River is common, and scenic integrity is moderate.

3.3.2. Environmental Consequences

Consequences of the impacts to visual resources are examined based on changes between the existing landscape and the landscape character after alteration, identifying changes in the landscape character based on commonly held perceptions of landscape beauty and the aesthetic sense of place.

No Action Alternative

Under the No Action Alternative, the scrubbers would not be installed, resulting in no need for a change in current industrial-based land use within the existing BRF boundary or along the Clinch River adjacent to the plant site. Visual character would remain in its current state.

Action Alternative

Under the Action Alternative, TVA would proceed with the installation of the scrubber module(s), resulting in a need to utilize current lands within BRF and along the Clinch River adjacent to the plant site in order to support activities associated with their construction, operation, and maintenance. Following is a discussion of potential visual impacts of the proposed scrubber and associated components.

New laydown and staging areas would be needed during construction, increasing the number of discordantly contrasting elements seen in the landscape around BRF. Additional visual disruptions would occur with an increase in equipment at construction sites.

Permanent impacts would include minor discernable alterations that would be viewed in the foreground of plant operations and would become visually subordinate to the overall landscape character associated with the plant site. A new smokestack would be constructed near the existing plant structures. This smokestack would likely be visible in the middleground and background distances by motorists and area residents, but when viewed in context with existing plant structures would remain subordinate to the established landscape character. Water vapor plumes from the new smokestack would be seen from points near BRF that have views of the existing smokestack plumes now. See Figure 3-3 for the view of a typical TVA fossil plant's water vapor flume. Motorists and residents farther away from BRF may have views of the new water vapor plume, depending upon atmospheric conditions and viewer location. The new plume would be larger than the existing plume and would be viewed as a focal point in the landscape. However, water vapor plumes of this nature tend to dissipate quickly. Upon completion of the new scrubber and associated work, the existing smokestack may be used if the scrubber is bypassed.

Figure 3-3. Example of Cumberland Fossil Plant's Water Vapor Plume

Views of clearing, site grading, and other site preparation activities from points along Edgemoor Road and from the Clinch River would remain in context with the existing industrial setting, and the scenic value would not be substantially diminished. Minor increases in truck traffic during the transportation of limestone would be visually insignificant compared to the volume of traffic seen along Edgemoor Road now. If barge delivery along the Clinch River were preferred for transporting limestone to BRF, increases would likely be visually insignificant for area residents and recreational users.

The construction, operation, and maintenance of the new scrubber would have insignificant visual impacts for area residents, motorists, recreation users, and BRF employees and visitors. There may be some minor visual discord during the construction and subsequent post-construction maintenance period due to an increase in personnel and equipment and the use of laydown and materials storage areas. These minor visual obtrusions would be temporary until all areas have been restored using TVA standard BMPs (Muncy, 1999). Therefore, there are no significant visual impacts anticipated as a result of this project, and no mitigation measures are necessary.

3.4. Noise

3.4.1. Affected Environment

The plant site is bordered by wooded ridges on the north and south, a partially wooded valley to the east, and the Clinch River on the west. There are nearby homes located in the valley and on both ridges. The residences most affected by plant noise are north of the plant on the south side of the ridge or at the top of the ridge. The noise levels at homes on the north-facing slope of the ridge to the north and on the south-facing slope of the ridge to the south are considerably lower due to the noise reduction of the terrain. The partially wooded hills across the river are undeveloped federal properties used for informal recreation.

Ambient noise was measured with a Bruel&Kjaer 2237 Integrating Sound Level Meter on November 10, 2004. Measurements were taken in nine locations surrounding the plant; these locations are shown in Figure 3-4. Locations 5, 6, and 8 are adjacent to the nearest residences that would be most affected by additional noise at the plant; these locations are also affected by traffic noise on Edgemoor Road.

Noise levels were measured three to five times at each location with each measurement lasting for 5 minutes. Leq is the continuous equivalent sound level or the “average” noise level during the measurement period. While Leq is very valuable for describing continuous noises, it is less useful for intermittent noises such as traffic. Leq smoothes out the discrete high-level events, such as trucks passing, to the point of eliminating the annoyance factor of the events. MaxP is the maximum peak sound level during the measurement, which is an important descriptor for intermittent noises. The average Leq and the MaxP of the measurements are shown in Table 3-11.

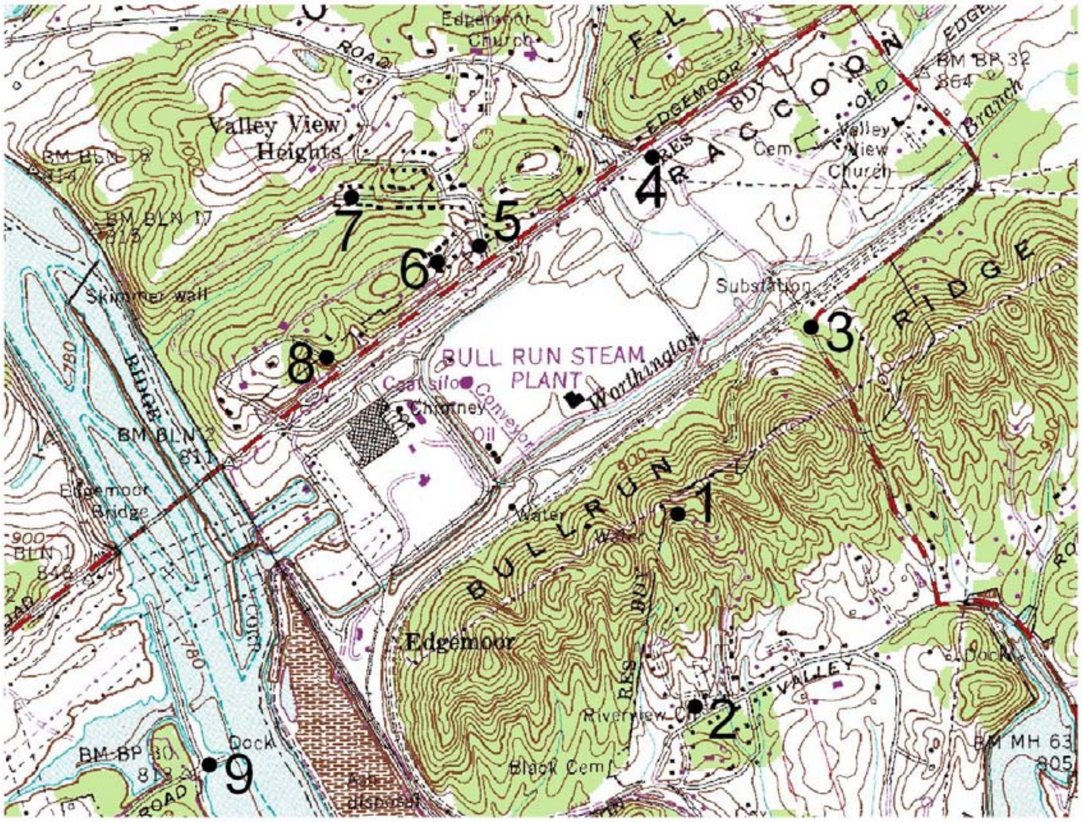


Figure 3-4. Map of Noise Measurement Locations

Table 3-11. Noise Measurements Surrounding Bull Run Fossil Plant		
Measurement Location	**Average Leq (dBA)**	**MaxP**
1. At the end of Lakeview Ferry Lane	47	84
2. At Riverview Baptist Church on Old Blacksberry Lane	40	80
3. On New Henderson Road at the TVA property line	59	102
4. On Edgemoor Road near ball fields	69	103
5. On Walnut Valley Road at the TVA property line	66	98
6. At the end of Crest Lane	55	89
7. At the end of Walnut Valley Road	42	87
8. At the east end of Lakeview Circle at the TVA property line	65	94
9. At the end of Old Edgemoor Road on the west side of the river	50	94

dBA = Decibel, A-weighted

Average noise levels in rural areas are typically around 40 decibels, a-weighted (dBA) during the day, so noise levels on Old Blacksberry Lane and at the end of Walnut Valley Road are fairly typical for rural areas. These two areas are protected from plant and highway noise by terrain. However, noise levels at the other locations are more typical of a setting adjacent to a large industrial site or highway.

3.4.2. Environmental Consequences

3.4.2.1. Construction

Construction would normally take place during weekday/daytime hours; however, construction could occur during nights or weekends if necessary to maintain schedule. Noise occurring between 10 p.m. and 7 a.m. is normally considered more annoying than noise occurring during the day, so the plan to limit construction activities to daytime hours would help to reduce possible noise impacts. The first phase of construction would be site preparation, which would use compactors, front loaders, scrapers, excavators, and graders. This type of equipment is expected to generate noise levels from 79 to 88 dBA at 50 feet (USEPA, 1971). The next phase of construction includes the building of the limestone preparation area, ball mill, FGD system, new stack, and gypsum handling system. This phase would use concrete mixers, cranes, pumps, generators, and compressors, which would generate noise levels from 76 to 85 dBA at 50 feet (USEPA, 1971). The final phase of construction would be clean up and testing, which would not use equipment that generates significant noise. In general, noise from construction activities would be similar to noise from current plant operations.

Maximum construction noise of 88 dBA at 50 feet would be about 60 dBA at the nearest residence approximately 0.25 mile away. This would likely be audible over background noise levels during periods of low traffic on Edgemoor Road, but it would not increase average noise levels significantly.

Because of the temporary nature of construction, the similarity of construction noise to plant operating noise, and the high noise levels of traffic in the area, noise impacts from construction are expected to be insignificant.

3.4.2.2. Flue Gas Desulfurization Operation

Operation of the proposed scrubber and ball mill would generate additional noise. The vendor specification for the ball mill is 85 dBA at 3 feet. This noise level would not be audible over background noise levels at the nearest residence 0.25 mile away. The FGD system would include slurry pumps, pump motors, modulating control valves, valve motors, oxidation air system blowers and blower motors, agitation system motors, and induced draft fan motors. The vendor specifications of each of these components require noise levels not to exceed 85 dBA at 3 feet. However, because of the additive effect of noise sources located close to one another, the total FGD operating noise level is likely to be somewhat higher than 85 dBA. If we assume the FGD system generates 95 dBA at 3 feet, the noise level at the nearest residence (0.25-mile away) would be approximately 43 dBA, which is not expected to be audible over background noise.

3.4.2.3. Limestone Delivery

In addition to the operation of the FGD system, another potential noise impact would be noise from limestone delivery. Limestone would only be delivered on weekdays during the day shift. Limestone could be delivered to the plant by truck, barge, or rail.

If limestone were delivered by truck, at least two possible routes could be used. See Section 3-2 for more details on the proposed truck delivery options. This evaluation conservatively estimates the total number of trucks that might be used. Three possibilities were considered: (a) 98 trucks per day on Pellissippi Parkway and Edgemoor Road, (b) 68 trucks per day on Pellissippi Parkway and Edgemoor Road, and (c) 68 trucks per day on Pellissippi Parkway and Edgemoor Road (west of the plant) plus 30 trucks per day on Clinton Highway and Edgemoor Road (east of the plant). Predicted noise levels were calculated using Federal Highway Administration's (FHWA) Traffic Noise Model (FHWA, 1998) and are shown in Table 3-12.

Table 3-12. Predicted Traffic Noise for Proposed Action

	Pellissippi Parkway (200 feet)	Edgemoor Road (150 feet)	Clinton Highway (150 feet)
98 trucks per day on Pellissippi Parkway and Edgemoor Road			
Predicted existing noise	70.8	68.3	---
Predicted future noise	70.9	68.5	---
Predicted increase in noise	0.1	0.2	---
68 trucks per day on Pellissippi Parkway and Edgemoor Road			
Predicted existing noise	70.8	68.3	---
Predicted future noise	70.9	68.5	---
Predicted increase in noise	0.1	0.2	---
68 trucks per day on Pellissippi Parkway and Edgemoor Road plus 30 trucks per day on Clinton Highway and Edgemoor Road			
Predicted existing noise	70.8	68.3	68.7
Predicted future noise	70.9	68.5	68.8
Predicted increase in noise	0.1	0.2	0.1

To determine traffic noise impacts, predicted future noise levels were compared with existing levels. FHWA regulations consider an impact exists if predicted future levels "substantially exceed" existing levels; however, FHWA does not define "substantially exceed" (FHWA, 1995). Tennessee Department of Transportation (TDOT) defines three levels of impacts: An increase of 5 dBA or less is defined as "no impact," an increase of 6 to 15 dBA is defined as a "moderate impact," and an increase greater than 15 dBA is defined as a "substantial impact." These criteria of impacts were used for this analysis.

In comparing predicted future traffic noise with existing traffic noise, there would be no more than a 0.2 dBA increase in hourly average noise levels. According to TDOT's criteria, this slight increase would result in "no impact."

If limestone were delivered by barge, the major noise source would be the clamshell bucket unloader. Two barges of limestone would be delivered each week and it would take less than 2 hours to unload each barge. The clamshell bucket unloader is expected to generate approximately 65 dBA at 590 feet (Edison Electric Institute, 1984) which would be about 53 dBA at the nearest residence. Due to the infrequent use and high existing noise levels, this is not expected to increase noise significantly at nearby residences above existing plant and traffic noise.

If limestone were delivered by rail, it would be unloaded with a rotary car dumper. There would be approximately 1.2 trains per week and each train would be unloaded in less than an hour. A coal rotary car dumper is expected to generate approximately 63 dBA at 590 feet (Edison Electric Institute, 1984), which would be about 52 dBA at the nearest residence. However, the limestone car dumper is expected to be louder than the coal car dumper due to the larger chunks and higher density of limestone. There is an acoustic wall adjacent to the coal car dumper. An acoustic wall would also be built for the limestone dumper, which would reduce the noise at the nearby residences. Due to the acoustic wall, the infrequent use, and high existing noise levels, this is not expected to increase noise significantly at nearby residences above existing plant and traffic noise.

Based upon this evaluation, this project would not have a significant effect on the noise environment of the surrounding area.

3.5. Surface Water and Wastewater

3.5.1. Affected Environment

Resource Description
BRF is located on the left bank of Melton Hill Reservoir in Anderson County, Tennessee, at CRM 48.0. The main plant area is drained by Worthington Branch, and the region southeast of Bull Run Ridge is drained by Bull Run Creek. Worthington Branch, a meandering creek draining Raccoon Valley, was relocated to the south side of the valley during plant construction. The length of relocation of the creek on the BRF site was approximately 1.6 miles. Bull Run Creek essentially follows its original watercourse except for straightening from the L&N Railroad bridge to its confluence with the Clinch River. An unnamed stream is also located on the plant site that bisects the bottom ash disposal area.

Clinch River
The Clinch River originates in southwestern Virginia. It flows into Tennessee and enters the Tennessee River near Kingston, Tennessee. Two impoundments, Norris and Melton Hill, are located on the Clinch River. BRF is located 31.8 river miles downstream from Norris Dam and 24.9 river miles upstream from Melton Hill Dam. Flow in the Clinch River in the vicinity of the BRF is dependent upon the releases through the hydroelectric plant at Norris Dam and releases from Melton Hill Dam. At the plant site, the main river channel is about 26 feet deep and 696 feet wide.

The Clinch River watershed drains approximately 4400 square miles above the plant. The watershed supports both small farms and light industry, with heavy industry occurring in urban areas. Boating, fishing, and water sports are popular on the Clinch River. TDEC, in partnership with a coalition of federal, state, and regional government agencies; nongovernmental organizations; and conservation groups and citizens, completed the *Tennessee River Assessment Project Summary Report* in 1998 that rated the Clinch

River's natural scenic quality as part regionally and part locally significant. Recreational boating on the Clinch River was rated as regionally significant, and recreational fishing was not assessed (TDEC, 1998). TDEC's 2004 305(b) report (TDEC, 2004a) states that historic DOE activities have resulted in mercury and polychlorinated biphenyl contamination of East Fork Poplar Creek and Melton Hill Reservoir downstream of BRF.

BRF plant has three active NPDES permitted process wastewater discharges to the Clinch River: the ash pond (Outfall 001), condenser cooling water (Outfall 002), and intake screen backwash (Outfall 004). BRF also has several outfalls of storm water permitted under the Tennessee Multi-sector General Permit for storm water runoff associated with industrial activity. The plant intake channel is also located on the Clinch River, upstream from Outfalls 001 and 002.

Bull Run Creek

Bull Run Creek drains a 104-square-mile area including portions of Anderson, Knox, Union, and Grainger Counties and empties into the Clinch River at CRM 46.7, just south of the southwest corner of the plant boundary. The ash pond and the east and west dredge ponds (closed) are adjacent to Bull Run Creek. The average flow for Bull Run Creek at mile 0.9 is estimated to be 4.25 cubic meters per second based on monthly measurements from 1957 to 1986 (Lowery, et al., 1986). The Tennessee River Assessment Project Summary Report rates Bull Run Creek's natural scenic quality as part regionally significant. The report did not assess recreational boating. Water quality in Bull Run Creek is rated as fully supporting its designated uses by TDEC (2004b) except for an 11.8-mile segment in Knox County that is not supporting designated uses. BRF does not have any discharges to Bull Run Creek permitted under NPDES Permit TN0005410.

Worthington Branch

The fly ash stacking area, dry stacking area runoff pond, coal storage yard pond, coal storage area, and main plant site are adjacent to Worthington Branch. Worthington Branch empties into the condenser cooling water discharge channel to the Clinch River. The minimum 7-day low flow that occurs once in 10 years (7Q10) stream flow data for Worthington Branch was obtained from nearby continuous gauging stations with a mean value of 0.268 cubic feet per second. Worthington Branch has had significant rerouting and channelization from its original course through BRF in the past by previous plant activities.

Unnamed Stream

A small unnamed stream borders the bottom ash and dry bottom ash storage area and drains into the Clinch River CRM 47.1. Streamflow data were not available for this unnamed stream. This unnamed stream has had significant rerouting and channelization from its original course through BRF in the past by previous plant activities.

Existing Coal Combustion Byproducts (CCB) Wastewater Treatment Facilities

As described below, the CCB handling system utilizes a number of areas, which receive and treat wastewater effluents including the ash pond and the bottom ash storage area and bottom ash pond.

Fly Ash

BRF is expected to burn between 2.0 and 2.2 million tons of coal annually through at least 2014. The coal averages 9.6 percent ash; therefore, total ash production will average approximately 230,000 cubic yards of ash per year. The ash is collected as either fly ash, which is fine enough and light enough to be carried with the flue gas stream exiting the boiler, or as bottom ash, which is coarser and heavier and falls to the bottom of the boiler. The fly ash/bottom ash split is approximately 85 percent fly ash and 15 percent bottom ash.

Fly ash production is expected to average about 209,000 cubic yards per year. The fly ash handling system at BRF has been converted to a dry fly ash handling system. Prior to this, all fly ash and bottom ash was wet sluiced to the ash pond complex. Since the conversion, fly ash is separated from the flue gases in the electrostatic precipitators and is collected dry and pneumatically transported to a single 1700 cubic yard ash silo.

Dry fly ash that is not marketed can be conditioned with water and loaded into dump trucks for transport to the fly ash disposal or utilization areas. The maximum active area of exposed dry fly ash would be 10 acres or less (Dave Robinson, TVA, personal communications, September 2000). As stacking areas become inactive, they would be closed with an interim cover. The dry fly ash stack is graded to a 1 percent to 2 percent slope at the end of each day to limit ponding and encourage sheet flow runoff. Runoff from the dry fly ash stacking area drains to a sedimentation pond where it evaporates or overflows into the coal storage yard pond, which is pumped to the ash pond as needed (William Ross, TVA, personal communications, January 2005).

BRF also retains the capability to sluice fly ash to the ash pond complex. Fly ash is sluiced during unit startup and during operational problems, which could compromise the reliability of the dry fly ash collection system. In recent years, as much as one-third of the fly ash has been sluiced to the ash pond annually. Currently less than 20 percent of the fly ash produced is sluiced to the bottom ash pond.

About 18.3 million gallons per day (mgd) is discharged from the ash pond through NPDES Outfall 001. Outfall 001 discharges to CRM 48. The pH of the ash pond discharge generally ranges from 6.6 to 8.2. The current NPDES Permit contains limitations on the ash pond discharge for pH, oil and grease, total suspended solids, and toxicity. This permit also requires monitoring of nine metals including copper, lead, mercury, selenium, cadmium, chromium, iron, manganese, and silver. The ash pond currently receives wastewater from a number of sources as shown in Table 3-13.

Bottom Ash

Bottom ash collects in the bottom of the boiler and is washed from the boiler bottoms with jets of water and sluiced to a bottom ash dewatering area within the ash pond complex. Dewatered bottom ash is removed from these cells with pan scrapers and then carried to storage areas within the ash pond complex. Bottom ash production is expected to average 22,000 cubic yards per year, depending on coal burn, through 2014.

Table 3-13. Inflow Sources to the Ash Pond

Source	Inflow to Ash Pond (mgd)
Boiler bilge sump	1.6430
Hydroveyers (ash collection)	3.1900
Precipitator washdown sump	1.4390
Chemical treatment pond	0.0052
Dry fly ash washdown sump	0.0011
Forced draft fan cooling water	1.1920
Stack yard sump (equipment cooling water)	1.1170
Stack yard sump (floor drainage)	0.0290
Ash sluice water	6.8480
Fly ash silo area sump	0.0042
Demineralizer sump	0.0780
Coal yard drainage basin/sump (fly ash stacking area)	0.1365
Coal yard drainage basin/sump (coal storage area)	0.1550
Coal yard drainage basin/sump (floor/roof drains)	0.9716
Coal yard drainage basin/sump (evaporation)	-0.0970
Ash sluice line low point sump (yard runoff)	0.0141
Ash sluice line low point sump (electrical yard runoff)	0.0247
Ash sluice line low point sump (back parking lot runoff)	0.0177
Main station sump (equipment cooling water & leakage)	1.0380
Main station sump (service bay floor drainage)	0.0140
Main station sump (plant leakage - boilers)	0.0680
Main Station Sump (roof drains)	0.0041
Unwatering sumps (yard runoff)	0.0142
Precipitation onto ash pond	0.5003
Evaporation from ash pond	-0.1180
Total	18.2897

Source: Flow schematic in 2004 renewal application for NPDES Permit TN0005410

3.5.2. Environmental Consequences

Potential Impacts

Under the No Action Alternative, no FGD wastewater would be added to the water waste stream. Current water quality of the BRF discharge at all outfalls would be expected to be maintained. All NPDES requirements would continue to be met as before. The current Draft NPDES Permit includes new monitoring requirements for ammonia nitrogen and effluent limitations for selenium for the ash pond discharge (Outfall 001). These proposed requirements are listed in Table 3-14.

Table 3-14. Draft NPDES Discharge Requirements - Discharge Serial Number (DSN) 001

Effluent Characteristics	Effluent Limitations: Monthly Average mg/L or ppb	Effluent Limitations: Daily Maximum mg/L, ppb, or s.u.	Monitoring Requirements: Measurement Frequency	Monitoring Requirements: Sample Type
Flow (mgd)	Report	Report	1/week	Instantaneous
pH, s.u.	within range 6.0-9.0		1/week	Grab
Oil and Grease	12.0	16.0	1/month	Grab
Total Suspended Solids	26.0	84.0	1/month	Grab
Nitrogen, Ammonia Total (Plant Intake)	-	Report	2/month	Grab
Nitrogen, Ammonia Total (Effluent)	-	Report	2/month	Grab
Nitrogen, Ammonia Total (Net Discharge)	-	Report*	2/month	Calculated*
Copper, Total	-	Report	1/year	Grab
Lead, Total	-	Report	1/year	Grab
Mercury, Total	-	Report	1/year	Grab
Selenium, Total	0.0065	0.0195	1/year	Grab
Cadmium, Total	-	Report	1/year	Grab
Chromium, Total	-	Report	1/year	Grab
Iron, Total	-	Report	1/year	Grab
Manganese, Total	-	Report	1/year	Grab
Silver, Total	-	Report	1/year	Grab
IC_{25}	Survival, Reproduction and Growth in 100 percentEffluent		Annually	Composite**

Source: Draft December 2004 NPDES Permit TN0005410

mgd = million gallons per day; mg/L = milligrams per liter; ppb = parts per billion
s.u. = standard unit; IC_{25} = an estimate of the effluent concentration that is lethal to 25 percent of the test organisms in the time period prescribed by the test

* If a calculated value for net addition of ammonia as nitrogen exceeds an action concentration value of 1.0 mg/L, the permittee should investigate source(s) of ammonia, and proceed with a corrective action(s), if necessary. Furthermore, Environmental Assistance Center-Knoxville shall be notified within 24 hours from the time the permittee receives results indicating that an action value of 1.0 mg/L was exceeded.

** See Part III of draft NPDES Permit TN0005410 for methodology.

Under the No Action Alternative, plant surface runoff and permitted discharges would be unchanged due to scrubber construction, so wastewaters and their receiving surface waters would not be affected.

Construction Impacts

Wastewaters generated during construction of the proposed BRF FGD scrubber system may include construction storm water runoff, domestic sewage, dewatering of work areas, nondetergent equipment washings, and hydrostatic test discharges.

Construction Impacts from Surface Runoff - All construction activities would be within the existing plant site. The BRF site is a preexisting heavy industrial facility with BMPs already in place for control of site runoff and resulting siltation. Surface runoff would flow to existing facilities that must meet regulatory requirements. In addition, a Construction Storm Water Permit would be in effect that would require the development of a project-specific Storm Water Pollution Prevention Plan. This plan would identify specific BMPs to address construction-related activities, which would be implemented accordingly to ensure that storm water impacts are minimized and that no sediment or other polluting materials are introduced into receiving waters. This would include proper handling of dewatering discharges. Therefore, no impacts to surface water would be expected from construction and installation of the FGD reactor and associated limestone and FGD wastes storage, unloading and handling area, or systems.

Construction Workforce Domestic Sewage Disposal - A conservative peak estimate for workers on site at any one time during the scrubber project is 500. This is based on 300 for scrubber construction (all day shift), 160 permanent plant staff (day shift), and approximately 40 people working on site on small construction projects and/or unit outages. Portable toilets and existing facilities would be provided for the additional scrubber construction workforce. Outages occur routinely, and those additional workers would be handled by portable toilets. All portable toilets would be regularly pumped out and the sewage transported by tanker truck to a publicly owned treatment works accepting pump out.

Equipment washing - These discharges would be handled in accordance with BMPs developed in accordance with the Construction Storm Water Permit (that covers water-only cleaning) and/or NPDES Permit TN0005410.

Hydrostatic testing - These discharges would be handled in accordance with NPDES Permit TN0005410 or the TDEC General NPDES Permit for Discharges of Hydrostatic Test Water (TNG670000).

Addition of Culverts in Worthington Branch and Unnamed Tributary - The proposed rail delivery option would require installing a culvert (approximately 350 feet) in Worthington Branch. The truck delivery option would require the addition of a 50-foot retaining wall for potential changes in on-site roads to alleviate traffic congestion. The proposed action also includes redirecting the final 1000-foot section of the unnamed tributary from its current path through the bottom ash area to Bull Run Creek. This would require directing the unnamed tributary through a culvert in the area designated as 1A. This area is depicted in Figures 3-5 and 3-8 (close-up view) and is further described in Sections 3.6, 3.7, and 3.12. Any selected alternative that involves work in these streams would require obtaining TDEC ARAP and USACE 404 Permits, and appropriate mitigative actions would be performed.

Barge Terminals for Shipping Gypsum and/or Receiving Limestone - Construction of barge loading and/or unloading facilities, as depicted in Figure 2-2c, would have the highest potential to affect the water quality of the Clinch River adjacent to BRF. TDEC ARAP and USACE 404 Permits would be required for these activities, and the ARAP and 404 Permits would identify appropriate BMPs to minimize or mitigate impacts on the Clinch River.

Thus, with the implementation of BMPs, no significant impacts to Worthington Branch, Bull Run Creek, or the Clinch River are expected from construction activities.

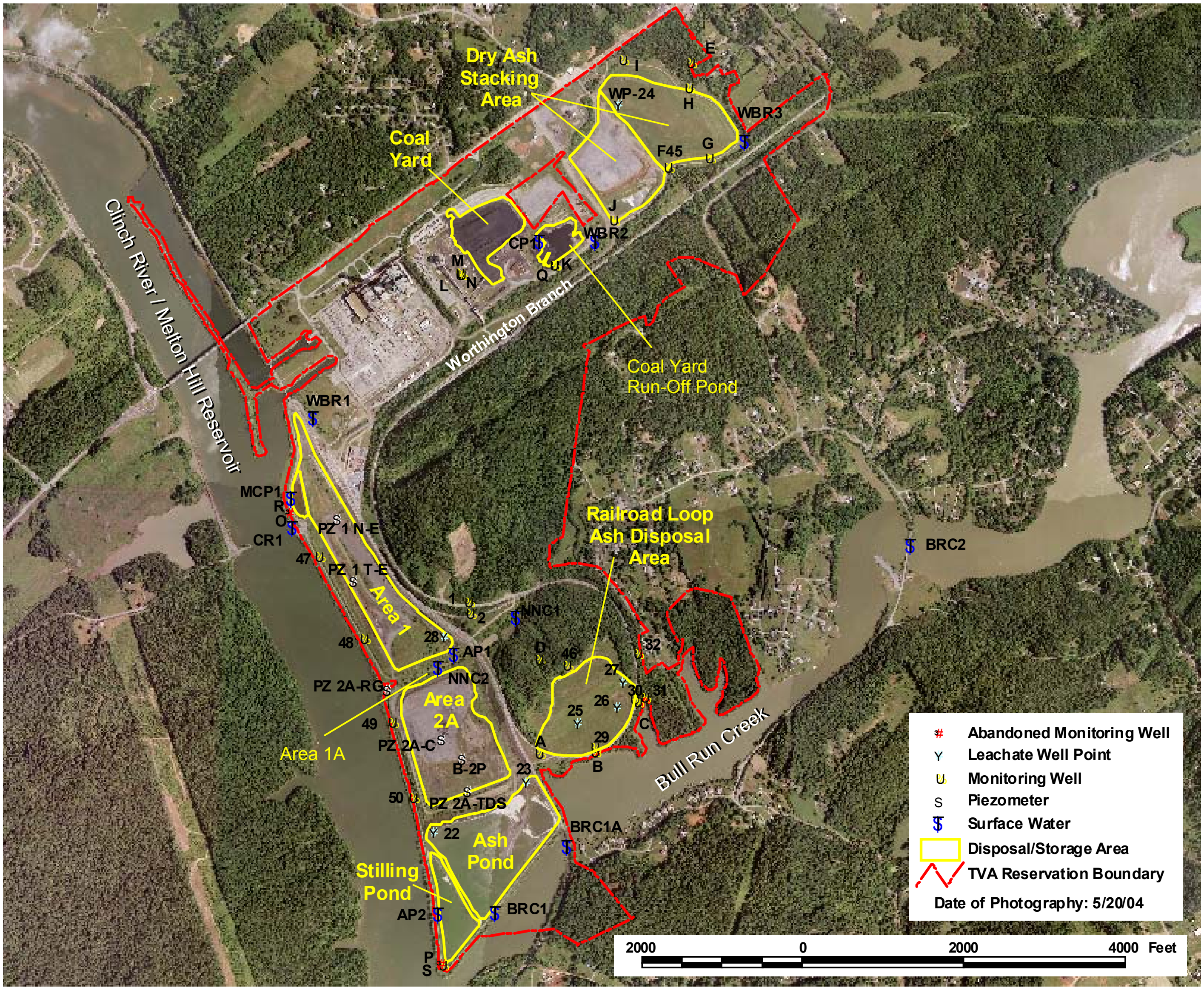


Figure 3-5. Ash Disposal Areas

Operational Impacts

The wastewater streams, which could change substantively under the proposed alternative, are the addition of FGD scrubber system wastewater, the ash pond effluent (Discharge Serial Number [DSN] 001), and the surface runoff from the proposed limestone handling area. The operation of the proposed scrubber would create an additional flow stream that would be eventually routed through the ash pond, as shown in Figure 2-1. The estimated flow from the proposed FGD system is approximately 431 gpm (0.62 mgd), which would increase the total discharge from the ash pond (DSN 001) from its current 18.29 mgd to approximately 18.91 mgd. The estimated maximum FGD flow would be 1028 gpm (1.48 mgd), which would increase the total discharge from the ash pond to approximately 19.77 mgd. This maximum flow would only occur during a scheduled outage in the unlikely event of a forced outage on the scrubber when FGD maintenance required completely draining the absorber unit. The flows of the bottom ash sluiced and the amount of fly ash hauled to the dry stack could change if a higher-sulfur coal were burned (see Sections 1.2.2 and 2.1.3), and the chemical characteristics of the ash pond effluent could also change because of burning higher-sulfur coal.

No FGD waste streams are expected or permitted to be discharged to Bull Run Creek, and results of limited sampling of Bull Run Creek seem to indicate no leachate contamination and significant dilution of groundwater recharge by surface water (Julian and Danzig, 1996). Therefore, no adverse impacts to Bull Run Creek are expected due to FGD operation.

Water Withdrawals for Process and Cooling Water for Scrubber System - Based on preliminary design information, water needs for the BRF scrubber have been estimated. Conservatively assuming 3.1 lb SO_2/mmBtu coal is burned, the total scrubber process water and equipment cooling water is conservatively estimated to be 3000 gpm. This water would be taken from the existing water system within the plant. No new intake structure would be required. Approximately 400 gpm would be used for equipment cooling, 2500 gpm for process needs, and 100 gpm would be for miscellaneous use. At this rate for a capacity factor of 75 percent, the scrubber would use approximately 986 million gallons of raw water annually. A little less than half of this would be returned to the river; the remainder would be discharged to the atmosphere as water vapor. The average usage would actually be somewhat lower than the estimate based on 2.5-4.0 lb SO_2/mmBtu, since BRF would be fired some of the time with coal whose sulfur content would produce an SO_2 emission rate lower than 3.1 lbs/mmBtu. The lower-sulfur content results in lower process water demand.

Because BRF uses river water for cooling, and the proposed barge terminal location is not far downstream of the CCW discharge channel, care must be taken to ensure that numerous barges do not remain moored in this vicinity for extended periods of time. Although it is unlikely that the current or proposed operations at BRF would result in a high volume of barge traffic, this is notable since experience at other TVA plants has shown that barges stacked two to four deep on moorings at other plants have caused excess upstream migration of heated discharge water, which may then enter the intake channel and occasionally force the plant to derate (curtail generation) to avoid an NPDES discharge water temperature violation (Hadjerious and Lindquist, 2001). At BRF, water temperature violations could typically occur in April and May, when releases from Norris Dam are at a minimum, and in October and November, when cold-water storage in Norris Reservoir may be depleted in some years. Excessive barge stacks can also cause velocity reduction and eddy currents in the plant discharge flow, encouraging deposition of sediment and accumulation of floating debris in the vicinity of the barges. The potential for this occurrence is low and insignificant.

Limestone Handling for Scrubber System - The limestone for the proposed FGD system would be delivered by truck, barge, or rail as described in Section 2.1.3 and Figures 2-2b to 2.2d. A conservative estimate for the limestone needed for the proposed FGD system is 179,000 tons/year. The runoff from the limestone storage areas would be collected and handled in the existing CCB wastewater treatment facilities.

Management of Scrubber Wastewater – The proposed addition of a wet LSFO FGD system to BRF would consist of the following:

- One absorber
- A system that receives bulk limestone and prepares a limestone slurry
- A gas handling system that would transport gas from the existing precipitators until emitted from the stack
- A new gypsum handling system

The proposed BRF FGD system would be downstream of the electrostatic precipitator and NOx reduction equipment. Gypsum is produced by the reaction of the limestone and SO_2 in the LSFO absorber. The absorber would contain limestone slurry in the lower portion and oxidation air that would be sparged or blown into the absorber liquid, would convert the dissolved calcium sulfite to calcium sulfate (gypsum). As the gypsum concentration reaches about 30 percent, slurry blowdown would be initiated to maintain design solids equilibrium. As described in Section 2.1.4 the estimated stream from the proposed FGD system would flow at approximately 431 gpm (0.62 mgd) and contain approximately 30 percent solids by weight. These solids would consist predominantly of gypsum crystals (>90 percent), but small amounts of unreacted limestone (<3 percent), other inert material (6 percent), and fly ash (<0.5 percent) would also be present.

Because of the high quality and market value of the gypsum expected, facilities are being proposed to process this material for barge transport to markets. The gypsum stream would be pumped from the absorber through aboveground and buried pipes to a proposed facility for dewatering (Figures 2-1 and 2-2a). As described earlier, the dewatering facility would consist of a staging area, mechanical type dryers, and loading/unloading areas. After dewatering, the gypsum would be transported to markets. Dewatered gypsum, having a moisture content of about 3 to 6 percent by weight, not immediately sold would be temporarily stacked in a storage area to await transport to purchasers. TVA predicts that the proposed disposal area, located in the ash pond complex, would accommodate the FGD gypsum byproduct for 11.5 years (assuming none is marketed). Marketing of the gypsum could extend the life expectancy of the proposed storage area indefinitely.

The amount of gypsum produced by LSFO scrubbing is dependent on the sulfur content and heating value of the coal, absorber efficiency and the amount of coal fired. Based on preliminary assumptions of fuel quality and TVA business plan coal-burn projections, estimates were prepared of the quantity of gypsum produced by the project. As noted above for the limestone, the estimates are based on conservative assumptions.

The annual gypsum production is expected to be 220,000 cubic yards per year (for gypsum composed primarily of calcium sulfate). Figures 2-1 and 3-5 show approximately the proposed location of the wet stack disposal area, which at 83 acres would be designed to accommodate nearly 2.6 million cubic yards of material. This would provide approximately 11.5 years of disposal capacity for the gypsum produced by BRF. TVA plans to mitigate depletion of the gypsum storage facility by aggressively marketing the gypsum.

The proposed gypsum storage area is located in the central portion of the current Ash Storage Area (Figures 2-1 and 3-5). Figure 2-2c shows a conceptual view of the proposed dewatering facility. Effluent from the dewatering facility would be directed to the existing ash pond.

The storm water runoff due to the proposed gypsum slurry dewatering transfer and storage systems associated with the BRF scrubber would have no significant impact on the aquatic environment of Worthington Branch, Bull Run Creek, or the Clinch River with the implementation of BMPs.

The worst-case scenario analyzed for this EA is an increase in the FGD wastewater stream to 1.48 mgd, which would increase its portion of the ash pond effluent (Outfall 001) from 3.3 percent to 7.5 percent. The current Draft NPDES Permit (TN0005410) contains effluent limits on Outfall 001 for pH, total suspended solids, oil and grease, ammonia (report with action level), selenium, and Whole Effluent Toxicity (WET).

The FGD wastewater would be treated in the existing CCB wastewater treatment facilities, which would provide sedimentation of particulates, neutralization by mixing with other wastewaters, and potential adsorption on the ash. Addition of FGD and limestone storage area wastewater to the ash pond system would therefore not be expected to have significant impacts on the ash pond effluent in regard to pH, total suspended solids, oil and grease, or ammonia.

In order to predict the potential for toxicity resulting from the scrubber addition, TVA conducted short-term chronic toxicity tests with fathead minnows (*Pimephales promelas*) and the daphnid *Ceriodaphnia dubia* using scrubber pond effluent from TVA's CUF mixed with BRF ash pond water at various proportions anticipated under operational conditions following installation of the FGD system. The CUF effluent was chosen as a surrogate for the BRF scrubber effluent due to similarities of the proposed fuels and the scrubber configuration at the two facilities. Results from tests conducted at 3.3 percent FGD effluent (expected percentage under normal operating conditions), 5.0 percent FGD effluent, and 7.5 percent FGD effluent (6.7 percent is the maximum expected concentration that could occur from an emergency discharge of the scrubber module to the gypsum disposal area) indicated no impacts to test organisms significant enough to jeopardize compliance with WET discharge limits.

At the expected range of FGD effluent (0.62 to 1.48 mgd), this wastewater could add an additional 4.91 to 11.73 pounds per day of total selenium to the ash pond system. If none of this selenium is removed in the ash pond by adsorption onto ash particles or iron oxyhydroxides, this additional selenium could increase the selenium loading in the ash pond effluent (Outfall 001) by approximately 350 to 690 percent. However, evaluation of ash pond influent and effluent data indicates that, on average, some removal (approximately 30 percent) of selenium occurs naturally in ash ponds. This may be due to co-precipitation with or adsorption onto the iron component of the pond chemistry. If similar reductions in selenium occur in the BRF ash pond system, this would reduce the additional selenium loadings from the FGD wastewater at Outfall 001 from 3.44 to 8.21 pounds per day.

No direct negative (toxic) impacts on the receiving stream (the Clinch River) would be anticipated because DSN 001 (ash pond effluent) would be required to meet NPDES limits that would be developed to be protective of designated uses. If selenium removal were needed to meet NPDES Permit limitations, TVA would select among several potentially effective technologies.

Technologies that can be utilized to remove selenium include sorption/adsorption, chemical treatment and precipitation, ion exchange, membrane separation, biological removal, and evaporation. Fixed-bed adsorption with granular ferric oxyhydroxide media utilizes highly adsorptive, single-use media that needs no pretreatment, suffers few interferences, and results in a small spent-media residual that is land fillable. Biological anaerobic treatment has been successful in treating mining operation wastewaters containing selenium (USEPA, 2001b). Single-use activated alumina adsorption has also been shown effective at removing selenite. If any of these technologies were needed, an appropriate environmental review would be conducted prior to implementation (EPRI, 1996 and 2004). Any reduction in toxicity necessary to meet WET or other limits would be met by necessary operational and treatment measures in the CCB wastewater treatment system. Thus, the proposed BRF scrubber system and the change to higher-sulfur coal would have no significant impact on the aquatic environment of Worthington Branch, Bull Run Creek, or the Clinch River.

3.6. Solid Waste and Groundwater

3.6.1. Affected Environment

BRF currently produces two CCBs: Fly ash and bottom ash are byproducts from the combustion coal and are disposed of on site. BRF burns approximately 2.2 million tons of coal annually. Fly ash comprises approximately 85 percent (approximately 209,000 cubic yards annually) of the ash produced from the combustion of the coal and bottom ash is the remaining 15 percent (approximately 22,000 cubic yards annually). Currently, less than 20 percent of the fly ash produced is sluiced to the bottom ash pond and is stacked with the approximately 22,000 cubic yards of bottom ash produced annually. In the past, disposal of fly ash and bottom ash at BRF has included sluicing to the ash pond, located on the east side of the Clinch River at CRM 47, with subsequent dredging and stacking of ash within Disposal Areas 1 and 2A (Figure 3-5). As these were filled, ash was dredged and stacked at a disposal site referred to as the Railroad Loop Ash Disposal Area. This site is now a closed landfill. Since 1983, fly ash has been mostly collected in a dry state and is currently disposed of in a permitted stacking area on the northeast side of the plant known as the Dry Stacking Area. Disposal Areas 1 and 2A are currently used for disposal of bottom ash and dredged fly ash.

Areas 1 and 2A are bisected by an unnamed tributary that currently flows to the Clinch River. This area is now referred to as Area 1A. Prior to the construction of BRF, this tributary flowed into Worthington Branch, which previously flowed to Bull Run Creek.

3.6.2. Environmental Consequences

No Action Alternative

If the No Action Alternative were chosen, the ash disposal area could continue to be operated as a bottom ash disposal area for at least the next 50 years.

Action Alternative

The addition of the scrubber would produce gypsum as a new byproduct. TVA proposes to market the gypsum. However, the gypsum that is not marketed would be disposed of on site. The proposed gypsum disposal facility at BRF is located on the east bank of the Clinch River/Melton Hill Reservoir near CRM 47 in Anderson County, Tennessee (Figure 3-5). The footprint of the new proposed gypsum disposal site encompasses approximately 83 acres within the existing ash disposal area (approximately 160 acres). Land surface across the disposal site ranges from elevation 810 to 845 feet mean sea level (ft-msl), and is entirely above the 100-year flood stage elevation (797.2 ft-msl at CRM 47). A permit application for the proposed disposal facility has been submitted to the Tennessee's Department of Environment and Conversation, Division of Solid Waste Management, and is currently under review.

The Class II CCB disposal facility proposed within the existing ash pond complex at BRF was evaluated for three possible disposal options within three different areas (Area 1, 1A, and 2A). The first option (Option 1) proposes disposal of bottom ash in Area 1, bottom and/or fly ash in Area 1A, and FGD-derived gypsum in Area 2A. All options include two alternatives for Area 1A: bottom ash only or a combination of bottom and fly ash. Option 2 is identical to Option 1 except that Area 2A would be used for the codisposal of FGD-derived gypsum, bottom ash, and dredged fly ash. Option 3 is identical to Option 1 except that Area 2A would be used for the disposal of sluiced fly ash (assumes no disposal of FGD-derived gypsum). In order to maximize the storage capacity in this area the unnamed tributary that bisects Area 1 and 2A would be culverted in the existing channel. This activity is discussed in detail in two sections of this EA: Surface Water and Wastewater and Flood Risk and Navigation.

The area designated as Area 2A would be modified to construct a wet stack to sluice and dispose of gypsum that is not marketed. It is estimated that the scrubber would produce approximately 220,000 cubic yards of gypsum per year. TVA expects to market for beneficial reuse all of the gypsum each year. However, if this assumption were incorrect, the location would accommodate 2.6 million cubic yards of material (Julian and Boggs, 2004). The wet stack would accommodate 1.8 million cubic yards of material, and the remaining 800,000 cubic yards of space would be available for dry stacking. This translates into approximately 8 years of wet disposal and 3.5 years of dry stacking capacity without any marketing. Areas 1 and 1A contain approximately 2.1 million cubic yards of capacity or approximately 23 years of capacity for bottom ash with sluiced fly ash. Any of the options listed above could be modified to maximize the life of the disposal facility for all of the CCBs produced at BRF.

TVA proposes to aggressively market the gypsum from this proposed activity. This action would extend the life of the on-site disposal facility for an indefinite period. Gypsum can be marketed for use in wallboard, cement, waste stabilization, and fill.

Hydrogeological evaluations of the proposed facilities associated with all options were performed to examine their suitability relative to the appropriate standards of TDEC Rule 1200-1-7. Evaluations addressed effects of proposed disposal facilities on local groundwater and surface water resources during both the operational and post-closure periods. Comparisons of water quality impacts for facility designs with and without a constructed 3-foot geologic buffer were also provided as the basis for an alternative to an artificial geologic buffer.

Recent site investigations supporting these evaluations included ten soil borings, installation and monitoring of ten piezometers and wells, single-well hydraulic conductivity (K) testing at four sites, and laboratory K testing of five undisturbed ash samples and one undisturbed alluvial soil sample. A 1999 survey of private water wells and public water supplies within 2 miles of the site was compared to the current TDEC database to determine current water use. Additional hydrogeologic data were obtained from previous studies in the existing ash disposal areas and included numerous soil and bedrock borings, water level data for six additional monitoring wells, field aquifer tests in soil and bedrock wells, and lab K measurements for soil and ash samples.

The first occurrence of groundwater below the area is generally within the existing ash fill. Groundwater movement at the site generally follows topography with shallow groundwater on the east side of the disposal area flowing toward the existing sluice pond and channel. However, the primary direction of groundwater movement is westerly toward the Clinch

River/Melton Hill Reservoir. All groundwater originating on, or flowing beneath, the proposed disposal site ultimately discharges to the reservoir without traversing private property.

The proposed CCB disposal facilities would be developed entirely on existing ash deposits. The environmental benefit of constructing an artificial 3-foot clay buffer at the base of Disposal Areas 1 and 2A was examined by numerically simulating leachate seepage from these disposal facilities with and without a clay buffer. Due to the linear configuration of Area 1 and its proximity to the sluice pond, model predictions indicate that the 3-foot clay buffer would reduce leachate seepage by only 0.6 percent for this facility. Regardless of the disposal option for Area 2A, the vast majority of leachate production associated with new gypsum and/or fly ash is intercepted by the proposed bottom ash drainage layer. Hence, a 3-foot clay buffer beneath Area 2A would reduce leachate seepage by only 1.2 to 4 percent.

Hydrogeologic conditions at the proposed disposal site appear to satisfy geologic and hydrologic standards for Class II disposal facilities. Key findings and recommendations are summarized as follows:

- Modeling results indicate that construction of an artificial 3-foot clay buffer having a hydraulic conductivity of 10^{-6} centimeters per second or less beneath the disposal areas would not provide a substantial environmental benefit. Model simulations show that leachate originating from existing ash beneath a clay buffer will continue migration toward the Clinch River in accordance with gradients governed by the sluice pond and channel. During the operational phases, predicted leachate seepage rates for the no-buffer and buffer designs differed by 4 percent or less under all design options. On this basis, construction of an artificial clay buffer is not recommended.
- Evaluation of CCB leachate seepage effects on local stream water quality further supports the suitability of the site for the proposed disposal options without an artificial geologic buffer. Numerical simulations were conducted to predict mass loadings for contaminants of concern under all disposal options. Volume-based dilution of leachate within the reservoir indicates that maximum contaminants of concern concentrations are typically three orders of magnitude less than applicable Drinking Water Maximum Contaminate Level's regardless of the disposal alternative.
- A survey of water use in 1999 identified four off-site wells within a 1-mile radius of the site and ten additional wells within a 2-mile radius of the site. This survey was confirmed by a 2004 database retrieval (TDEC, 2004b). None of the residential wells are located down gradient of the proposed facility. Furthermore, there is no potential for future development of groundwater supplies down gradient of the facility, since all property between the disposal site and surface water boundaries lies within the plant reservation.
- Consequently, potential impacts to groundwater from any of the options considered under the Action Alternative for disposal of gypsum are insignificant.

3.7. Flood Risk and Navigation

3.7.1. Affected Environment

Various aspects of this project would impact the floodplains of three water bodies on or adjacent to the BRF plant site. Option 1 could result in impacts from the addition of a retaining wall in Worthington Branch. Impacts may occur in Option 2 to the Clinch River from the construction of the barge terminal on the plant site (on the left bank of the river between CRMs 47 and 48). Option 3 could result in impacts to Worthington Branch from potential channel relocation, construction of additional culverts for the water to flow through, or lengthening of existing culverts. Impacts to the unnamed tributary at CRM 47.1 could result from lengthening of an existing culvert under the No Action Alternative or any of the options in the Action Alternative.

3.7.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, the existing conditions and trends described for water and flood risk in Melton Hill Reservoir and Worthington Branch are expected to continue. The unnamed tributary, however, will eventually be impacted by the need to expand the ash disposal areas adjacent to the Clinch River near the southern plant property boundary in any scenario including the No Action Alternative.

Action Alternative

The proposed action includes several modifications and additions to TVA's BRF complex in Anderson County, Tennessee. The site has been heavily disturbed by previous plant development activities, and the Clinch River, Worthington Branch, and the unnamed tributary have all been previously channelized to facilitate plant construction and operation. The Action Alternative considers three optional methods of delivering limestone to BRF, which could result in differing impacts to one or more of these streams. Table 3-15 summarizes the alternatives and their potential effect on the streams.

Detailed Discussion on Potential Stream Impacts of Limestone Receiving Options Under the Action Alternative

There are three different means by which limestone could be brought to BRF--by truck, barge, or rail. Under Option 1, limestone would be delivered via trucks. Roads on the plant site would be realigned to eliminate some current traffic problems. These realignments would only require that a retaining wall about 50 feet long be constructed on Worthington Branch at the outlet of the culvert on the right side of the channel at the former "Malfunction Junction" location. No culverts would be lengthened or added.

Option 2 considers delivery of limestone via barges on the Clinch River and construction of a barge unloading facility. This would require modification of about 800 feet of the left bank of the Clinch River around CRM 47.5 and construction and realignment of access roads on the plant site to allow transportation of the limestone from the barge unloading area to storage and processing areas.

Table 3-15. Stream Impacts on Bull Run Fossil Plant Site

Alternative	Description	Stream impacts
No Action	Continue current operations	*Clinch River*: none *Worthington Branch*: none *Unnamed Tributary*: will eventually require expansion of ash disposal area and culvert expansion where the creek currently flows between the two ash disposal areas
Action	Add FGD	
Option 1	Receive limestone via trucks	*Clinch River*: none *Worthington Branch*: retaining wall required on right bank at outlet of stream crossing at former "Malfunction Junction" location *Unnamed Tributary*: eventual culvert extension, as in No Action Alternative
Option 2	Receive limestone via barges on the Clinch River	*Clinch River*: Barge terminal constructed on left bank, south of condenser cooling water discharge channel *Worthington Branch*: none *Unnamed Tributary*: eventual culvert extension, as in No Action Alternative
Option 3	Rail delivery only with new 20 car rail line	*Clinch River*: None *Worthington Branch*: 350 foot culvert near east end of 20 car rail line, or relocate 350 feet of the branch closer to road on plant side of stream *Unnamed Tributary*: eventual culvert extension, as in No Action Alternative

Under Option 3, limestone would be delivered by rail. A new rail line would be constructed on the northern side of the existing rail line to accommodate 20 rail cars carrying limestone. A new truck road would also be constructed. This option would impact Worthington Branch at the east end of the rail line, where approximately 350 feet of stream would have to be moved or enclosed in a culvert.

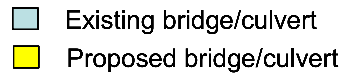
Table 3-15 above lists the potential impacts to streams from the three options under consideration. The following section describes potential impacts to the Clinch River and Worthington Branch. Because the impacts to the unnamed tributary are the same for the No Action and the Action Alternatives, it will be discussed separately.

Floodplain Impacts of Limestone Receiving Options on the Clinch River and Worthington Branch under the Action Alternative

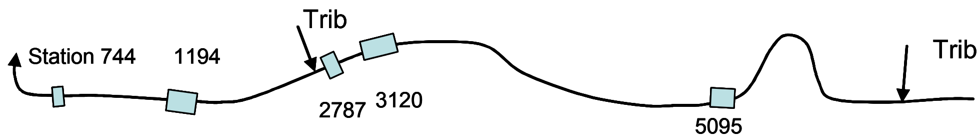
Evaluation of flood impacts for the three optional delivery approaches included consideration of the 2-year (50 percent chance), 10-year (10 percent chance), 100-year (1 percent chance), and 500-year (0.2 percent chance) floods to determine the potential magnitude of increased flood elevation, and the extent of the increase in the upstream and lateral directions.

Worthington Branch is the only stream that would be impacted differently under all of the different options (other than the barge terminal under Option 2). Figure 3-6 shows a schematic identifying the impacts to Worthington Branch from each option to be evaluated.

Stick Diagrams of Evaluated Alternatives on Worthington Branch

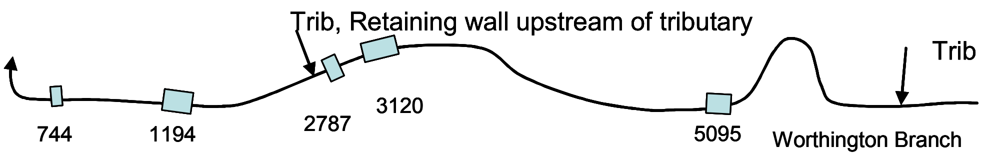


No Action



Option 1 – receive limestone via trucks only:

Some onsite road improvements, including retaining wall modification to one culvert

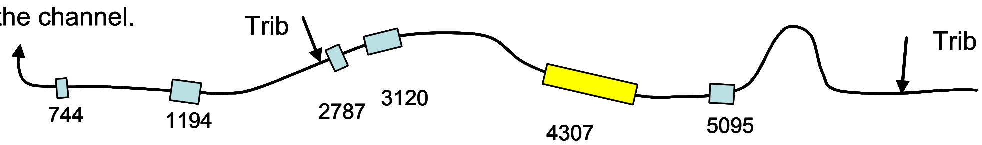


Option 2 – barge delivery:

New barge terminal on Clinch River, same as No Action Alternative

Option 3 - 20 rail car option with culvert:

New railroad track to unload 20 cars constructed to NW of existing track. The stream channel will be culverted with a 12'CMP for about 350 feet where the fill overlaps with the channel.



Option 3 - 20 rail car option without culvert – relocate channel:

New railroad track to unload 20 cars constructed to NW of existing track. Relocate about 500 feet of the channel to the north about 35 feet to accommodate the additional fill needed for the new rail line.

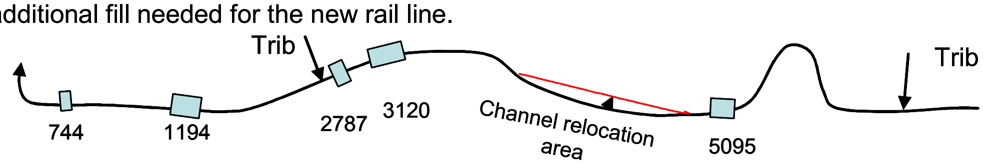


Figure 3-6. Stick Diagrams Illustrating Worthington Branch Impacts

Option 1: Flood impacts on Worthington Branch from constructing a 50-foot retaining wall in the channel, downstream of an existing culvert were evaluated. Impacts on flood elevations from this option were extremely minor, with flood elevations from this option actually *decreasing* a maximum of 0.14 foot, because the retaining wall would provide a small increase in flow area in the channel. This option produces the least amount of disturbance to the stream channel, as well, and has the fewest impacts to Worthington Branch of all the Action Alternative options. There would be no impacts to the Clinch River under Option 1

Impacts of Modifications to an Unnamed Tributary to the Clinch River Located Within the Existing Bottom Ash Disposal Area Under the Action and No Action Alternatives

The small tributary that currently flows between two separate ash disposal areas has already been heavily impacted by past culverting and channelization. For the purpose of this analysis, this stream will be referred to as the unnamed tributary. The unnamed tributary was evaluated for increases in flood elevations from replacing the channel between the two existing ash fill areas with a culvert and using the former channel area as additional ash fill space. Under both the Action and No Action Alternatives, approximately 1000 feet of a small, unnamed tributary to the Clinch River south of the main plant site would eventually be culverted to provide additional storage area for ash and gypsum.

This stream is a tributary to the Clinch River at CRM 47.1 and has a drainage area of about 0.2 square mile at the upstream side of the ash fill areas. The upper two-thirds of the watershed are extremely steep and wooded, running off a ridge and dropping rapidly in elevation toward the railroad loop and the ash fill areas. The red outline on Figure 3-7 delineates the boundary of this small watershed on a portion of a USGS 7.5-minute quad map (USGS, 1990). The current ash fill areas are indicated with brown horizontal hatch marks. They are divided by the channelized unnamed tributary.

Whether or not a limestone scrubber is installed at BRF, ash will continue to be produced from current operations, and expansion of the two ash fill areas will eventually be necessary. The proposed action, regardless of alternative, is to combine the two ash disposal areas into one large area and use the available storage space where the stream channel is currently located, by routing the stream through a culvert that will be buried by the ash and gypsum. The Action Alternative would accelerate the need for the ash fill expansion.

Currently, a road crossing just upstream of the ash fill area connects the two disposal areas on the riverward side. A combined road/railroad crossing over the stream connects the two ash fill areas on the landward boundary. The proposed culvert would simply connect these two existing roadway culverts with a long intermediate segment that would ultimately be buried by ash, allowing the ash fill to be expanded over the current location of the channel. The resulting structure would be a long, composite culvert that consists of four to five segments, beginning with the existing culverts in the road/rail crossing at the upstream end of the ash fill, a new 1000+ foot segment where the channel between the two ash fills was, and finally the existing downstream culverts at the river.

Figure 3-7. Delineation of the Unnamed Tributary's Watershed

The preferred design for the ash fill expansion culvert involves extending existing pipes somewhat and installing a junction box at each end of the new pipe to connect the existing culvert sizes and shapes with the proposed pipe system, which is a dual 42-inch high-density polyethylene pipe conveyance that would run much of the length of the 1000 feet between the two existing stream crossings.

Figure 3-8 illustrates a schematic of the existing and proposed conditions of the unnamed tributary.

The junction boxes provide the best means of transition between a single large culvert and the two smaller proposed culverts that would run underneath the ash fill. The proposed design and the pipe material were chosen because of their ability to withstand the great weight of the large amount of fill to be placed above the pipes without crushing. The junction boxes would not be buried and would serve as maintenance access points.

The USACE HEC-RAS hydraulics model was employed to evaluate the floodplain impacts of this channel modification and other waterway impacts related to this project. The flood risk evaluation showed that connecting the two downstream-most bridge structures with a long culvert and eventually filling the area with ash would increase flood elevations in all design scenarios run, due to a greater backwater effect from the less efficient flow through the longer culvert. The increases in water surface elevation varied from about 0.1 foot for the 2-year flood to 2.9 feet for the 500-year flood. The longitudinal extent of increased backwater elevations ranged from about 400 feet for the 2-year flood to about 700 feet for the 500-year flood, or the outlet of the railroad bridge on the northern side of the rail loop. The model stopped at the upstream side of the railroad bridge. From this point upward, the streambed profile is extremely steep, so there would be no differences in the water surface profile. Additionally there are no structures upstream of the railroad bridge to be impacted by flooding. Therefore, all flood impacts would be limited to TVA property.

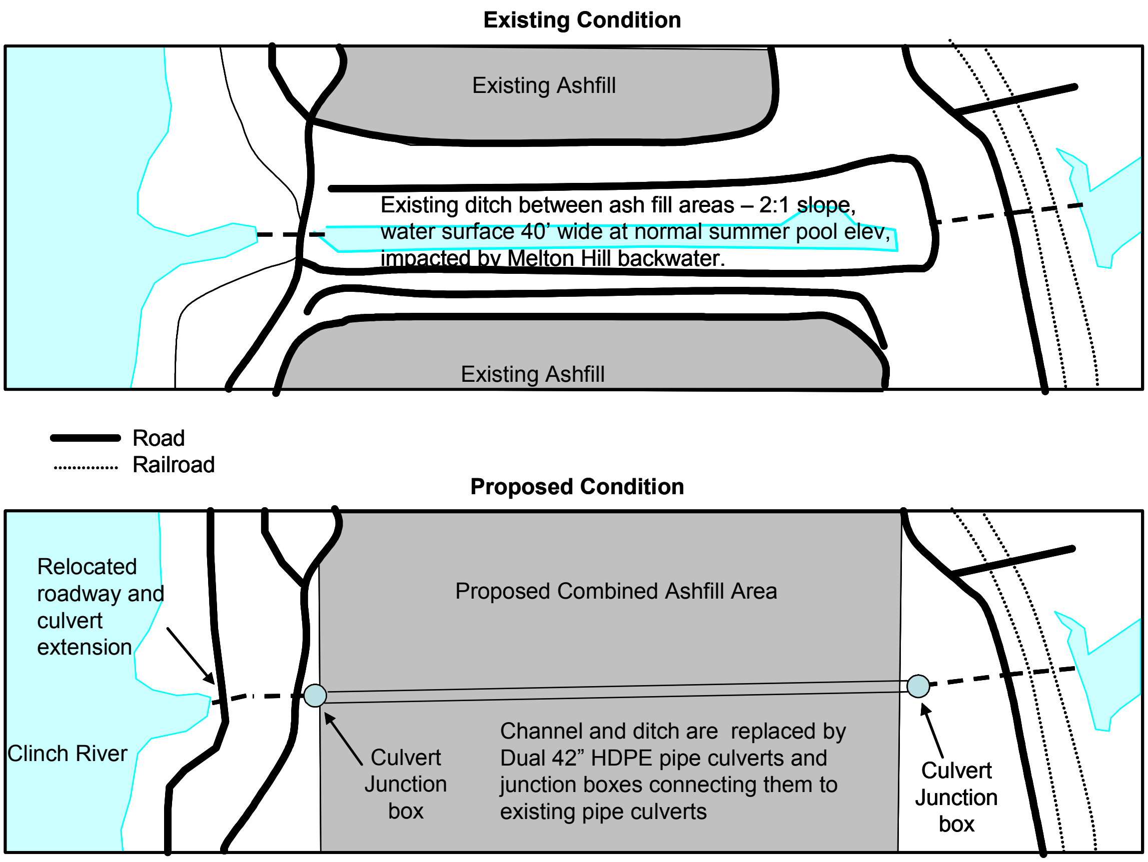


Figure 3-8. Existing and Proposed Ash Fill Areas and Creek Impacts for Area 1A

The flood analysis shows that only the 500-year flood in any alternative would overtop the railroad bridge in the northern part of the railroad loop. The railroad bridge in the western side of the railroad loop would not be overtopped by the 500-year flood, but the floodwater would come extremely close to inundating the tracks with the proposed culvert in place. The 100-year flood is passed through the composite pipe with a much smaller backwater effect and without a concern of the tracks being inundated. The need for the proposed expansion of the ash fill areas is not immediate, and it may be several years before any modifications would occur. During the interim, should the proposed culvert design change due to better available technology or for other reasons, the flood impacts would need to be reevaluated.

Option 2: On the Clinch River, it was necessary to determine whether there would be an increase in the 100-year flood and with-floodway elevations from the barge terminal.

To determine whether construction of the barge terminal facility on the Clinch River would require cutting into the bank to provide adequate depth for barges at the terminal location, the barge terminal location was superimposed on a bathymetric (underwater) 2-foot-contour map of the Clinch River in the vicinity of BRF, developed specifically for this analysis. The analysis was carried out at winter pool elevation, which is typically about 4.5 feet lower than the summer pool elevation. It assumes that barges draw 9 feet and should have at least 2 feet of water beneath them. The study concluded that some cutting would be required.

Figure 3-9 illustrates the Clinch River bathymetry. The cross section graphs in Figure 3-10 were plotted based on 9-foot draft at winter pool elevation. Winter pool elevation of Melton Hill Reservoir is 790 (it dropped to 789.8 in 1995; it typically drops to about 790.5 under current reservoir operation practices).

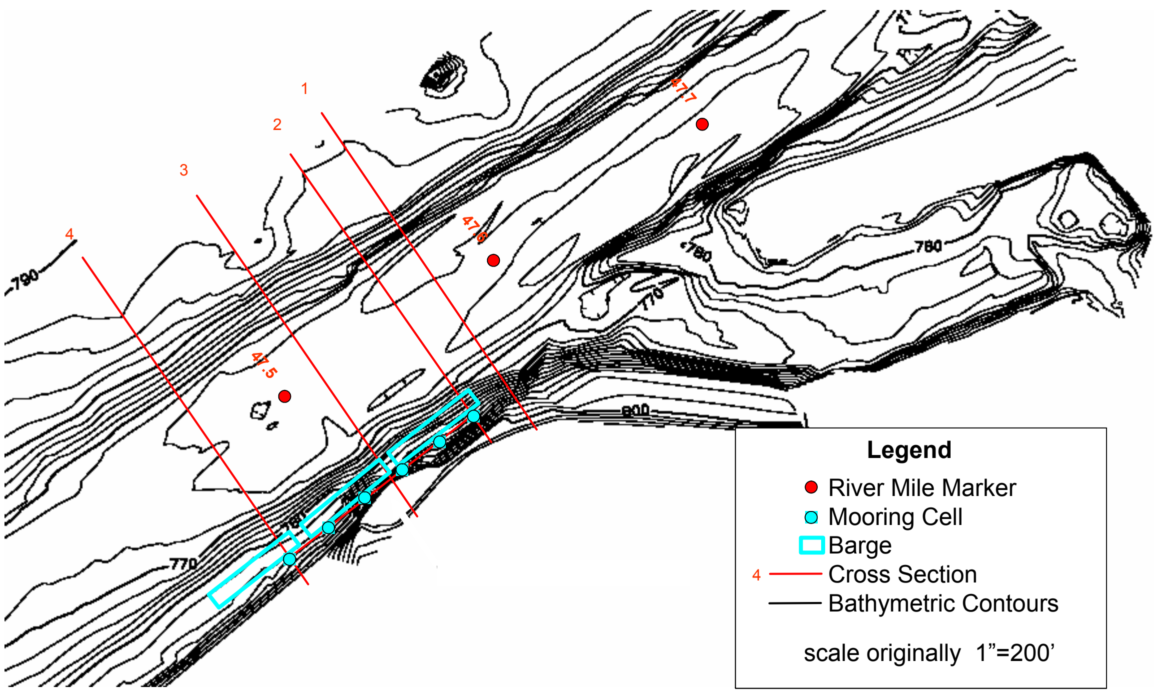


Figure 3-9. Clinch River Bathymetry With Barge Terminal Superimposed

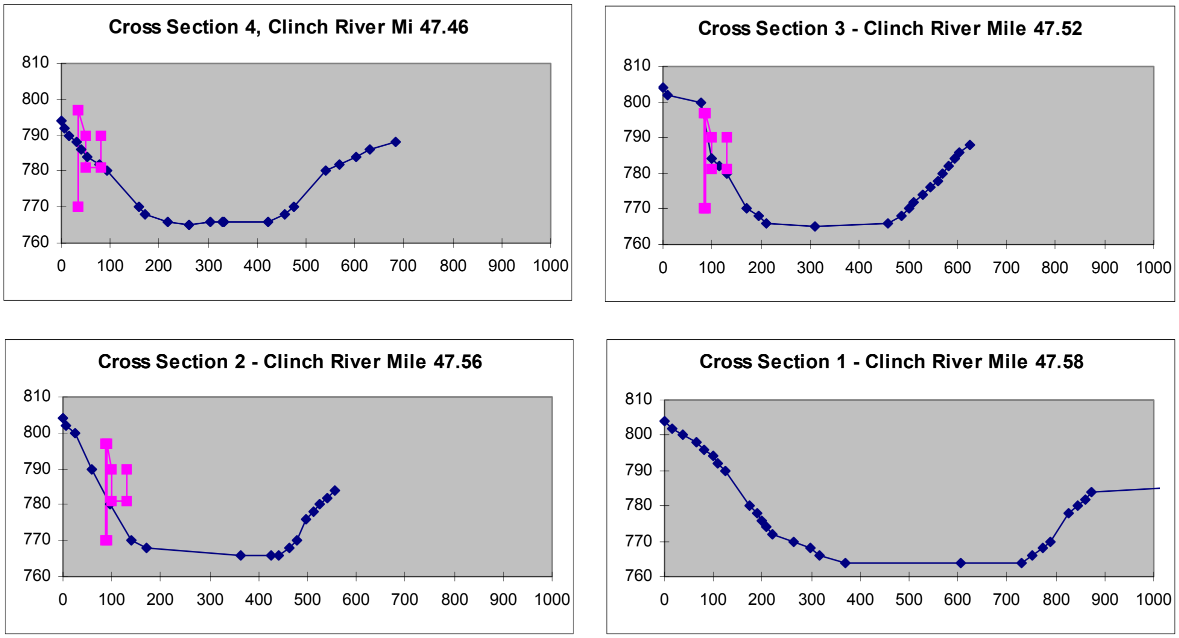


Figure 3-10. Clinch River Cross Sections With Barge Terminal Superimposed

Cross sections of the river bottom at Locations 1-4 on are shown in Figure 3-10. The portions of the stream bank that would require cutting to provide adequate barge depth are located where there is overlap between the barge cross section (pink) and the river cross section (blue). No additional sections were taken downstream of Section 4 due to the uniform-looking nature of the river bottom above elevation 770 in this general area. Section 4 can be considered generally representative of the remaining downstream area that could be impacted by the barge terminal.

Routine dredging would most likely be necessary for maintenance of adequate depth along the left bank of the Clinch River along the proposed terminal location. Spoil from any dredging activities to maintain the navigation channel and access to mooring facilities must be disposed of above the 500-year floodplain elevation of 798.0.

Peak Flood Evaluation. The USACE Hydrologic Engineering Center River Analysis System (HEC-RAS) model (USACE, 2003) was used to evaluate peak flood elevations on the Clinch River both with and without the barge facility. Flood discharges used in the Clinch River HEC-RAS model were previously determined for a flood study conducted for DOE in 2003.

The HEC-RAS model showed that addition of the proposed barge terminal and the required channel modification would cause no significant change in flood elevations from existing conditions. Simulations showed a change in water surface elevation between existing and proposed conditions of no more than +/- 0.01 foot on any flood profile, a negligible amount. The evaluated design produces no increase in the 100-year with-floodway elevation on the Clinch River. When completed, the actual as-built condition would need to be evaluated to demonstrate that it meets the no-rise certification. This certification requires demonstration via hydraulic modeling that there is no increase in the 100-year with-floodway elevation to satisfy the requirements of the National Flood Insurance Program. The city of Oak Ridge and Anderson County, Tennessee, participate (Federal Emergency Management Agency, 2004).

Flood Risk Evaluation. A flood risk evaluation of Worthington Branch for Option 2 was not performed, since there would be no changes in the current configuration.

Option 3: There are two proposals for delivery of limestone by rail. One proposal is to route about 350 feet of Worthington Branch through a culvert in order to retain the existing channel location and still have an acceptable 2:1 slope ratio from the railroad grade to the channel area. A second proposal is to relocate the channel near the end of the proposed rail line, rather than culverting it. There would be no impacts to the Clinch River under Option 3.

The evaluation of the addition of a 350-foot culvert showed minor increases in the 2- and 10-year floods. However, for the 100- and 500-year floods, the elevation showed increases with the culvert in place. For the 100-year flood, the maximum increase in water surface elevation was 2.2 feet, and the backwater impacts carried upstream about 1600 feet from the culvert. For the 500-year flood, the maximum increase in water surface elevation was 2.8 feet with the backwater impacts extending about 1600 feet upstream from the culvert. These impacts would be confined to the BRF reservation. The new culvert would be overtopped in the 500-year flood, but not in the 100-year flood.

Inspection of the topographic map suggests there is enough room between the proposed rail line location and the existing plant road on the far side of the channel to relocate the channel near the end of the proposed 20-car rail line. The analysis indicates that the channel would only need to be moved about 35 feet to the right (looking downstream), and there is enough room to do this without compromising the existing plant road. The impacts to flood elevations from channel relocation would be minimal and insignificant, essentially mimicking existing conditions.

Additional Impacts of Construction, Operation, And Maintenance of a Barge Unloading Facility

Option 2 construction, operation, and maintenance of a barge unloading facility at BRF would have negligible impacts on flood elevations on the Clinch River. Under the preferred alternative, the barge terminal would be located between CRMs 47.5 and 47.7, just downstream of the BRF condenser cooling water (CCW) discharge channel.

Summary of Flood Impacts and Conclusions

Flood risk impacts from Option 1 are limited to Worthington Branch and include a small reduction in water surface elevations on Worthington Branch just downstream of the bridge crossing at Station 2787 due to the addition of a retaining wall, which would slightly increase the channel area. The retaining wall, considered a repetitive action under EO 11988, meets EO requirements by minimizing flood risk and producing no adverse impacts.

Flood risk impacts from Option 2 are limited to the Clinch River between CRMs 45.5 and 45.7. The barge terminal is considered a functionally dependent use under EO 11988, and hydraulic analyses show that the terminal would not increase 100-year flood or floodway elevations, producing no adverse impacts and meeting EO 11988 requirements.

Option 3 would impact Worthington Branch by either requiring construction of a 350-foot culvert or relocating the channel to provide adequate space for a new rail line located on the stream’s left bank and well above the floodplain. Both of these actions are considered repetitive under EO 11988. The culvert action would locally increase flood elevations above current conditions; however all increases would be confined to the plant property, and in most locations, the 500-year flood would be confined to the channel or produce only very shallow flooding on the right bank. Relocating the channel would produce no increase in flood elevations and in terms of flood risk minimization, would be the preferred choice for this option due to the absence of flood impacts.

The lengthening of the culvert on the unnamed tributary has no practicable alternative under EO 11988 due to geographic limitations of the ash fill location, and the culvert is considered a repetitive action. Although the design would increase flood elevations, the impacts are minimized by the chosen design and pipe materials, and all increases in flood elevations would be confined to TVA property.

3.8. Aquatic Life

3.8.1. Affected Environment

This reach of Melton Hill Reservoir transitions from the upstream riverine reach to the more lacustrine conditions found nearer the dam. Overbank areas near BRF are very shallow. The Bull Run Creek embayment enters the reservoir on the left bank about 1.5 river miles downstream of the BRF CCW discharge at CRM 47.7. The dominant factor influencing aquatic resources of Melton Hill Reservoir, especially the upper and midreservoir areas, is the cold water entering from Norris Dam discharges. Although warmed somewhat by the BRF discharge, temperatures are still marginally low to support warm-water biota and marginally warm to support cold-water biota (TVA, 1999).

TVA began a program to monitor the ecological conditions of its reservoirs systematically in 1990. Previously, reservoir studies had been confined to assessments to meet specific needs as they arose. Reservoir (and stream) monitoring programs were combined with TVA's fish tissue and bacteriological studies to form an integrated Vital Signs Monitoring Program. Vital signs monitoring activities focus on (1) physical/chemical characteristics of waters; (2) physical/chemical characteristics of sediments; (3) benthic macroinvertebrate community sampling; and (4) fish assemblage sampling (TVA, 1999).

Benthic (lake bottom) macroinvertebrate and fish samples were taken in three areas of Melton Hill Reservoir from 1991 through 1994, and again in 1996 and 1998, as part of TVA's Reservoir Vital Signs Monitoring Program. Areas sampled included the forebay (area of the reservoir nearest the dam), a midreservoir transition station in the vicinity of CRM 45.0, and an upper-reservoir inflow station near the US 25W bridge at Clinton. Although other fish species could occur in the vicinity of BRF, results of sampling at the transition station are presented here because they would be most representative of fish and benthic communities in the vicinity of BRF.

Benthic macroinvertebrates are included in aquatic monitoring programs because of their importance to the aquatic food chain, and because they have limited capability of movement, thereby preventing them from avoiding undesirable conditions. Sampling and data analysis were based on seven parameters that include species diversity, presence of selected taxa that are indicative of good water quality, occurrence of long-lived organisms, total abundance of all organisms except those indicative of poor water quality, proportion of total abundance comprised by pollution-tolerant oligochaetes, proportion of total abundance comprised by the two most abundant taxa, and proportion of samples withy no organisms present. Compared to the transition stations of other TVA run-of-the-river reservoirs, the transition station benthic community rated fair in 1994, 1996, and 1998 sampling largely because of low total abundance of all species present (TVA, 1999).

The Reservoir Vital Signs Monitoring Program also has included annual fish sampling at Melton Hill from 1990 through 1994 and in 1996 and 1998. Fish are included in aquatic monitoring programs because they are important to the aquatic food chain and because they have a long life cycle that allows them to reflect conditions over time. Fish are also important to the public for aesthetic, recreational, and commercial reasons. Ratings are based primarily on fish community structure and function. Also considered in the rating is the percentage of the sample represented by omnivore and insectivores, overall number or fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, deformities, etc. (TVA, 1999). Compared to other run-of-the-river reservoirs, the fish assemblage at the Melton Hill midreservoir station rated poor in 1992; fair in 1990, 1991, and 1996; but good in 1993, 1994, and 1998. Species diversity and abundance are generally not as high as in other run-of-the-river reservoirs. More abundant species in the sample were gizzard shad, common carp, and bluegill (TVA, 1999).

Beginning in 2001, additional fish community samples have been collected biennially at two locations in Melton Hill Reservoir (CRM 45 and CRM 52) near BRF for a study evaluating CWA 316a thermal compliance. Results of that sampling indicate poor fish communities upstream of the plant and good communities downstream of the plant. A total of 39 fish species were collected at the transition in TVA's most recent year of sampling in 2003 stations combined (Table 3-16).

Melton Hill provides opportunities for sport anglers. A Sport Fishing Index (SFI) has been developed to measure sport fishing quality for various species in Tennessee and Cumberland Valley Reservoirs (Hickman, 1999). The SFI is based on the results of fish population sampling by TVA and state resource agencies and, when available, results of angler success as measured by state resource agencies (i.e., bass tournament results and creel surveys). In 1998, Melton Hill rated average for black bass species (largemouth, smallmouth, and spotted bass), but below average for striped bass and bluegill.

Recent Tennessee Wildlife Resources Agency (TWRA) fish collections at Melton Hill indicate relatively low productivity and standing crop. Fluctuating water temperatures due to cold tailwater releases from Norris Reservoir were thought possibly to affect reproductive success and growth rates of warm-water fish species. Although no creel census data are available for Melton Hill, catch rates in TWRA electrofishing samples indicate that largemouth bass provide the major black bass fishery, with older largemouth experiencing slow growth and relatively low mortality. Muskellunge were stocked in 1998, with additional future stocking planned in an effort to create a sport fishery for this cool-water species (TWRA, 1999).

Worthington Branch is a small stream that drains most of the BRF site (most of the watershed lies outside the site.) TVA sampled aquatic life in Worthington Branch in January 2002 (TVA, 2002b) at a site in the free-flowing reach above the influence of the Melton Hill pool.

Sampling of fish and benthic animals indicates that Worthington Branch is impacted by siltation and possibly domestic waste. Eleven species of fish were collected; a lack of species intolerant of degraded conditions and low catch rate of all species were noted. The benthic animal assemblage showed considerable impairment as evidenced by the poor representation of sensitive species, and by reduced density of families that were present.

A short distance downstream from the BRF discharge canal, an unnamed tributary enters Melton Hill Reservoir at CRM 47.1. Approximately 1000 feet of this small tributary separates two ash disposal areas. The waters of this tributary drain a small pond immediately upstream of the railroad tracks on the east border of the ash disposal areas and enter the Clinch River in an underwater culvert of unknown diameter predating the filling of Melton Hill Reservoir. Water covering the culvert is of reservoir origin, and the stream banks are essentially disposed ash. This small embayment, virtually a ditch, is inaccessible to the public and is unlikely to contain aquatic habitat suitable for sustaining normal aquatic life.

3.8.2. Environmental Consequences

No Action Alternative

For the No Action Alternative, the existing conditions and trends described for aquatic life in Melton Hill Reservoir and Worthington Branch are expected to continue.

Action Alternative

The proposed action is located within TVA's BRF complex in Anderson County, Tennessee, along the Clinch River on Melton Hill Reservoir. Land use in the project area is exclusively associated with the day-to-day operations of the fossil power generating facility. This area has been heavily disturbed by previous plant development activities. Worthington Branch passes through the area of proposed scrubber construction. Judging from the lack of stream sinuosity of Worthington Branch within the project boundaries, it is most likely that the stream has been previously modified (i.e., channelized or moved) to facilitate plant construction and operation.

Options for Limestone Receiving

Option 1 would receive limestone via trucks, with the hopper located east of the surge bins. Some site preparation would be needed, such as grading, if this option were chosen. A new retaining wall may be added to alleviate traffic congestion just below the road to the current coal rail unloading facility. All activities would be conducted using BMPs to minimize potential impacts to surface waters in Worthington Branch, a small unnamed tributary to the Clinch River, or the main stem of the Clinch River (Melton Hill Reservoir). Because this alternative would not result in significant impacts to surface waters, no impacts to protected aquatic species would occur.

Option 2 would receive the limestone via barges on the Clinch River. Construction of a barge unloading facility would be necessary. This option has the highest potential to impact aquatic life in the construction area along the adjacent portion of Melton Hill Reservoir Because this alternative would not result in significant impacts to surface waters, no impacts to protected aquatic species would occur.

Option 3 is rail delivery of the limestone. Under this option, two new rail lines would be constructed on the northern side of the existing rail line to accommodate 20 rail cars. A new truck road would also be constructed. This option affects Worthington Branch, especially on the upper end where approximately 350 feet of stream might have to be moved or enclosed in a culvert. Additionally, smaller impacts may also be caused by creation of an area for limestone stockout.

Table 3-16. Fish Species Collected Fall Electrofishing and Gill Netting Samples at two Sites (CRM 45 and CRM 52) in the Vicinity of Bull Run Fossil Plant, Melton Hill Reservoir, 2003

Common Name	Scientific Name	CRM 45	CRM 52
Skipjack herring	Alosa chrysochloris	X	
Gizzard shad	Dorosoma cepedianum	X	X
Rainbow trout	Onchorhynchus mykiss		X
Muskellunge	Esox masquinongy	X	
Common carp	Cyprinus carpio	X	X
Spotfin shiner	Cyprinella spiloptera	X	X
Bluntnose minnow	Pimephales notatus	X	X
River carpsucker	Carpiodes carpio	X	X
Quillback	Carpiodes cyprinus	X	X
Northern hog sucker	Hypentelium nigricans	X	
Smallmouth buffalo	Ictiobus bubalus	X	X
Black buffalo	Ictiobus niger	X	
Spotted sucker	Minytrema melanops	X	X
Silver redhorse	Moxostoma anisurum	X	X
Black redhorse	Moxostoma duquesnei	X	X
Golden redhorse	Moxostoma erythrurum	X	X
Channel catfish	Ictalurus punctatus	X	X
Flathead catfish	Pylodictus olivaris	X	
Yellow bass	Morone mississippiensis	X	X
Striped bass	Morone saxatilis		X
Rock bass	Ambloplites rupestris	X	X
Warmouth	Lepomis gulosus	X	X
Redbreast sunfish	Lepomis auritus	X	
Green sunfish	Lepomis cyanellus	X	X
Bluegill	Lepomis macrochirus	X	X
Longear sunfish	Lepomis megalotis		X
Redear sunfish	Lepomis microlophus	X	X
Hybrid sunfish	Lepomis spp.	X	X
Smallmouth bass	Micropterus dolomieu	X	X
Spotted bass	Micropterus punctulatus	X	
Largemouth bass	Micropterus salmoides	X	X
White crappie	Pomoxis annularis	X	
Snubnose darter	Etheostoma simoterum		X
Yellow perch	Perca flavescens		X
Logperch	Percina caprodes	X	
Sauger	Sander canadense	X	X
Walleye	Sander vitreus		X
Freshwater drum	Aplodinotus grunniens	X	X
Banded sculpin	Cottus carolinae	_	X
Total species		**32**	**30**

Impacts From Construction and Operation of the Scrubber Facility, Railway Unloading Area, and Truck Unloading and Access Improvements

Construction of the proposed scrubber facility and associated rail or truck support facilities would not result in any significant changes to water quality in the Clinch River with the implementation of standard BMPs during construction of the facility. No impacts to aquatic life in the Clinch River would occur under these options.

Operational discharges from cooling systems and settling ponds associated with this facility would be permitted under the existing NPDES Permit, and would have no adverse effect on water quality in the Clinch River. Therefore, none of these actions would have any direct significant impacts on aquatic life in the Clinch River.

Impacts of Modifications to an Unnamed Tributary to the Clinch River Located Within the Existing Bottom Ash Disposal Area

Approximately 1000 feet of a small tributary drainage would be culverted to provide storage area for gypsum produced from the use of this scrubber facility under the Action Alternative. This waterway has been heavily impacted by past culverting and channelization and does not sustain quality habitat for aquatic species; therefore, impacts to it would not be significant.

Impacts of Construction, Operation, and Maintenance of a Barge Unloading Facility

Construction, operation, and maintenance of a barge unloading facility at BRF would have direct impacts to habitats and water quality in the Clinch River adjacent to BRF. Dredging activities required for maintaining the navigation channel and construction of docking and mooring facilities would have direct in-stream impacts and would impact aquatic life in the adjacent portion of the Clinch River (Melton Hill Reservoir). The area to be disturbed lies along the existing bottom ash disposal area. This section of the Clinch River has historically been impacted by fill activities from bottom ash storage, and the thermal regime in this stretch of river is directly impacted by cooling discharge from BRF. This reach of the Clinch River has been filled from operations at BRF and does not sustain quality habitat for aquatic species, therefore impacts to it would not be significant.

Applicable ARAP and USACE 404 Permits would be obtained for all options, and the terms and conditions of these permits would require mitigation from these proposed activities.

3.9. Terrestrial Ecology (Animals)

3.9.1. Affected Environment

Much of the area encompassing BRF is designed for industrial use. Nonvegetated areas include developed hardscapes, buildings, roadways, construction sites, and disposal areas. These areas have very little value to wildlife.

Vegetated habitat is patchy throughout the landscape. Areas bordering or interspersed with hardscape include broomsedge/fescue fields and scrub-shrub. Birds and possibly small mammals use these fields for foraging and roosting. White-tailed deer use these areas for foraging; their tracks were identified in the area. Scrub-shrub habitat in the project area consists of shrubs especially exotic invasives such as multifloral rose, amur honeysuckle, and privet. Small trees such as redbud, young oaks, and elms are intermixed with the shrubs. Scrub-shrub provides nesting habitat for Carolina wrens, northern mockingbirds, song sparrows, eastern towhees, and northern cardinals and also provides winter habitat for migrants such as white-throated sparrows. Pine and mixed forests occur within the boundary of the fossil plant. These areas may provide habitat for brown-headed nuthatches, pine warblers, and the state listed sharp-shinned hawk. A marsh occurs at the southern end of the plant boundary. This marshy area may provide habitat for swamp sparrows, red-winged blackbirds, sora, and the state-listed common moorhen. Muskrat trail were identified in the marsh.

3.9.2. Environmental Consequences

No Action Alternative
Under the No Action alternative, BRF would likely remain in its current state. Therefore, terrestrial animals and their habitats would not be affected.

Action Alternative
The majority of the project area consists of hardscape, which is of very little value to wildlife. Vegetated areas are fragmented and consist of low-quality habitat for wildlife. Marsh and pine habitat would not be affected by this project. Worthington Branch is not known to have listed species. This stream does not provide habitat for hellbenders, Black Mountain dusky salamanders, Tennessee cave salamanders, and four-toed salamanders. None of the options proposed by this project would eliminate high-quality wildlife habitat from the area.

3.10. Terrestrial Ecology (Plants)

3.10.1. Affected Environment

BRF is located within the Ridge and Valley Physiographic Province as defined by Fenneman (1938). This province lies between the Blue Ridge Mountains and the Cumberland Plateau and is characterized by prominent, northwest-trending ridges and their associated valleys. The low ridges and knobs of the project area are a result of a dissection of the valley floor. Botanically, the proposed project site coincides with the Ridge and Valley section of the Oak-Chestnut Forest Region (Braun, 1950).

In the region of eastern Tennessee where the proposed project occurs, native forest communities generally consist of white oak communities, with white oak as the dominant canopy species. Frequent accompanying species include tulip tree, hickories, southern red oak, black oak, and white pine.

The area in and around BRF has been heavily impacted and altered as a result of the construction and operation of the existing facilities. In November 2004, field inspections of the areas associated with the proposed action reveal that little native vegetation remains. The proposed scrubber project would impact several areas within the BRF reservation. The vegetated areas to be impacted consist of grass/forbs habitats, lands predominantly maintained as lawns, fields, and thickets intergrading to immature forests; stream and associated wetland habitats; and industrial areas that include roads, parking lots, buildings, and railroad structures. The following areas are sites designated within BRF potentially to be impacted by the installation of scrubbers.

The proposed limestone truck receiving area Option 1 is comprised mostly of industrial areas, especially roads (approximately 75 percent). The remaining area is partially adjacent to a small stream comprised mostly of privet, redbud, and Johnson grass and partially over a mowed area of plantain and Johnson grass.

The proposed limestone barge receiving area Option 2 is partially along the Clinch River, which is comprised of privet, sericea lespedeza, goldenrod, and common plantain; partially in a field that constitutes broomsedge, smooth sumac, mimosa, giant plume grass, sericea lespedeza, and goldenrod; and partially in existing roads and parking lots.

The proposed limestone rail receiving area Option 3, like Option 1, is primarily in an existing industrial area primarily made up of roads. A portion of te receiving area is a mowed area of common plantain and Bermuda grass adjacent a thicket intergrading into a mature forest comprised of Carolina buckthorn, amur honeysuckle, goldenrod, blackberry, broomsedge, sericea lespedeza, Japanese honeysuckle, and eastern red cedar. The receiving area also momentarily crosses a drainage stream comprised mostly of privet, boxelder, and amur honeysuckle.

The proposed road layout area is an existing industrial area with many roads with pockets of mowed grass along the sides.

The proposed gypsum and dredged ash disposal area is mostly in a current bottom ash disposal area with little to no vegetation. Sections that are vegetated are partially adjacent to a stream and associated hydric vegetation habitat that is comprised mainly of common reed, privet, and giant plume grass and partially in a thicket intergrading into an immature forest that consists of giant plume grass, broomsedge, blackberry, Virginia pine, mimosa, goldenrod, smooth sumac, and Japanese honeysuckle.

The proposed byproduct disposal area is in a field that includes goldenrod, tall fescue, broomsedge, and wingstem and is dissected by a small landfill drainage ditch consisting of upland willow, black willow, common rush, and bulrush.

The proposed Laydown Area #1 (area nearest the Clinch River) is in a mowed area of common plantain and Johnson grass used as a baseball field.

The proposed Laydown Area #2 (area behind Laydown Area #1) is mostly in an industrial area with roads and a parking area.

The proposed Laydown Area #3 (area furthest away from the Clinch River) is mostly in an industrial area heavy disturbed due to current construction.

The proposed dewatering facility is made up of approximately 25 percent of an industrial area made up of roads and parking lots. The vegetated sections are partially in a field consisting of giant plume grass, broomsedge, smooth sumac, sericea lespedeza, and mimosa and partially in a mowed area that briefly crosses a stream and associated wetland habitat, a small ditch that includes Johnson grass, mimosa, and sericea lespedeza.

The vegetation of all reviewed areas is common and representative of disturbed areas in the vicinity. No uncommon plant communities are present on or adjacent to the reviewed areas.

3.10.2. Environmental Consequences

No Action Alternative
The lands within the BRF reservation would remain as they are now for the foreseeable future. No project-related impacts to uncommon terrestrial communities or otherwise unusual vegetation would be expected as a result of this alternative.

Action Alternative

Some disturbance of existing plant communities would occur with implementation of project plans. Since virtually all areas have been heavily disturbed by construction and operation of BRF and no uncommon terrestrial communities or otherwise unusual vegetation occurs on the lands to be disturbed by the proposed action, impacts to the terrestrial ecology of the region are expected to be insignificant.

3.11. Endangered, Threatened, and Rare Species (Animals)

3.11.1. Affected Environment

A review of the TVA Natural Heritage database indicated that 17 protected species have been reported from Anderson and Knox Counties (Table 3-17). All 17 species are protected by the state of Tennessee. Two species (the gray bat and Indiana bat) are federally protected.

State-Listed Species

Four state-listed amphibians are reported from Anderson and Knox Counties. Eastern hellbenders are found in large and midsize, fast flowing, rocky rivers at elevations below 762 meters (Petranka, 1998). They have been collected in the Clinch and Tennessee Rivers and their tributaries in the two counties. Hellbenders have been collected near the BRF. Black Mountain dusky salamanders occur in mostly permanent, small to moderate-sized streams flowing through mesophytic forests (Petranka, 1998). They prefer streams with a steep to moderate gradients and coarse gravel or rocky substrates (Redmond, 1980). All records for this species are from the forested mountains northwest of BRF. Tennessee cave salamanders occur in caves including those formed in sinkholes. All records for this species are over 8 miles from BRF in Knox County. The closest cave to the project site is approximately 2 miles. No Tennessee cave salamanders have been reported from this cave. Finally, four-toed salamanders occur in forested swamps, bogs, vernal pools, and other fish-free habitats, especially those with mossy banks. The only record for this species is from the forested mountains northwest of the BRF.

Two state-listed raptors are reported from Anderson and Knox Counties. Sharp-shined hawks nest within coniferous and mixed woodlands. One record occurs 18 miles from the BRF in Knox County. Fragmented pine and mixed forests do occur within the vicinity of the fossil plant. Peregrine falcons nest predominantly on cliffs, though there are records of peregrines nesting in trees in Tennessee. There is one nesting record from Knox County. Peregrines currently do not nest at this site, and no known nesting of peregrines is known for the two counties.

Three state-listed songbirds are reported from Anderson and Knox Counties. Cerulean warblers inhabit and nest in mature, moist deciduous forests in the Ridge and Valley Physiographic Region. The three records from Anderson County are all from intact, forested areas. Swainson's warblers occur in forested habitat with a thick understory, typically near streams. Both records for this species occur in the forested mountains of Anderson County. Appalachian Bewick's wrens occur in brushy areas, thickets, and scrub in open areas. There is one historical record from 1908 from Anderson County. This species has most likely been extirpated from the region. Common moorhens nest in marshes and ponds with areas of open water and abundant aquatic vegetation (Nicholson, 1997). One record occurs for the two counties. The record is from 1970 of a nesting pair in Knox County. Since 1970, the marsh it nested in has been partially filled in for highway and commercial development. Marginal habitat exists for this bird at BRF.

Table 3-17. Protected Species of Terrestrial Animals Reported From Anderson and Knox Counties, Tennessee

Common Name	Scientific Name	Federal Status	State Status
Amphibian			
Eastern Hellbender	*Cryptobranchus alleghaniensis alleghaniensis*		Deemed in Need of Management
Black Mountain Dusky Salamander	*Desmognathus welteri*		Deemed in Need of Management
Tennessee Cave Salamander	*Gyrinophilus palleucus*		Threatened
Four-toed Salamander	*Hemidactylium scutatum*		Deemed in Need of Management
Bird			
Sharp-shined Hawk	*Accipiter striatus*		Deemed in Need of Management
Cerulean Warbler	*Dendroica cerulea*		Deemed in Need of Management
Peregrine Falcon	*Falco peregrinus*		Endangered
Common Moorhen	*Gallinule chloropus*		Deemed in Need of Management
Swainson’s Warbler	*Limnothlypis swainsonii*		Deemed in Need of Management
Appalachian Bewick’s Wren	*Thryomanes bewickii altus*		Endangered
Barn Owl	*Tyto alba*		Deemed in Need of Management
Mammals			
Gray Bat	*Myotis grisescens*	Listed Endangered	Endangered
Indiana Bat	*Myotis sodalis*	Listed Endangered	Endangered
Allegheny Woodrat	*Neotoma magister*		Deemed in Need of Management
Smoky Shrew	*Sorex fumeus*		Deemed in Need of Management
Southeastern Shrew	*Sorex longirostris*		Deemed in Need of Management
Reptiles			
Northern Pine Snake	*Pituophis melanoleucus melanoleucus*		Threatened

Barn owls roost and nest in cavities including caves, hollow trees, barns, and silos. They forage over open landscape, such as abandoned farmland, but also in urban habitat, such as vacant lots, cemeteries, and parks (Nicholson, 1997). Two barn owl sites are located approximately 5 miles from the BRF.

Allegheny woodrats inhabit rocky cliffs and talus slopes. The species is rarely found in lowlands or in open spaces. Woodrats nest amongst rocks but have been found to nest in abandoned buildings. One record occurs over 16 miles from the BRF. Habitat exists in the forested mountains northwest of the fossil plant.

Two shrews, state-listed as in need of management, are recorded from the project area. Smoky shrews inhabit cool, damp hemlock and spruce forests as well as deciduous forests with a deep layer of leaf mold on the ground. They have also been taken in bogs and swamps (Linzey, 1998). Southeastern shrews are found in mostly moist situations in woods or fields (Linzey, 1998) including disturbed habitat such as abandoned fields with dense ground cover of honeysuckle, grasses, sedges, and herbs (Linzey and Brecht, 2002). Numerous records occur for both species. The closest record is approximately 5 miles from the BRF.

This Southeastern shrew occurs in a variety of habitats from fields to forests. Habitat in early stages of succession and disturbed habitat, such as cultivated fields and abandoned fields with dense ground cover of honeysuckle, grasses, sedges, and herbs, seem to be favored.

Northern pine snakes inhabit sandy pine barrens, dry ridges and hillsides. It has been found in thickets dominated by Virginia pine, mountain laurel, and rhododendron. One record occurs for the two counties. This record is approximately 16 miles from the BRF.

Federal Listed Species

Indiana bats, federally listed as endangered, roost in caves during the winter, and form summer roosts under the bark of living and dead trees. Their summer roosts are found in forests with an open understory usually near water. The only Indiana bat roost cave known for Anderson County is over 14 miles from the BRF. This roost is also considered historical. Gray bats, also federally listed as endangered, roost in caves during all seasons and forage over open water habitats. Five gray bat caves are known from the two counties. All of these caves are over 8 miles from the BRF. The only other record for Anderson County is from the Oak Ridge Y-12 Plant.

3.11.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, BRF would likely remain in its current state. Therefore, this alternative would not result in adverse impacts to protected terrestrial animal species or their habitats.

Action Alternative

State Listed Species

According to the TVA Natural Heritage database, two state- and no federally listed species were recorded from within 3 miles of the project site. Two caves and one heronry occur within 3 miles of the project site. Both caves are approximately 1.5 miles from the project site. The heronry is 1.2 miles from the site. These are all adequate distances from the site. No impacts would occur to these resources.

Suitable habitat for Black Mountain dusky salamanders, Tennessee cave salamanders, four-toed salamanders, cerulean warblers, peregrine falcons, Swainson’s warblers, smoky shrews, and Allegheny woodrats does not exist within the boundaries of the project site. Peregrine falcons may be present in the area at certain times of the year, but they would not utilize the area for nesting since no habitat exists. No impacts are expected to any of these listed species.

Hellbenders occur within the Clinch River adjacent to the fossil plant. The proposed project would incur no impacts on the river; therefore, no impacts are expected to the hellbender.

Sharp-shined hawks may nest within the pines within and near the fossil plant. The pines would not be disturbed during the construction of the proposed project. No impacts are expected to this species.

Common moorhens may nest within the marshes found at the southern end of the fossil plant property. This habitat would not be disturbed during the construction of the proposed project. No impacts are expected to this species.

There is one record of an Appalachian Bewick's wren from 1908. This species is considered extirpated from the region; therefore, no impacts are expected.

Barn owls may forage within the boundaries of the fossil plant. Foraging habitat may be minimally disturbed at the potential byproduct disposal area. The amount of foraging habitat that could be lost is inconsequential, since there are plenty of other foraging habitats in the general area.

The vegetated areas of BRF may provide suitable habitat for southeastern shrews. Minimal disturbances to this habitat would occur during the proposed project work, and regional populations would remain intact. No impacts are expected to this species.

No northern pine snake habitat would be disturbed due to the proposed project. No impacts are expected to this species.

Federal Listed Species

The five caves containing federally listed gray bats reported from the two counties are all over 8 miles from BRF. All potential gray bat caves that are within 3 miles of the project site are at adequate distances. Gray bats forage over open water. Option 2 would increase barge traffic on the Clinch River, though this should not affect gray bat foraging. No impacts are expected to this species.

Suitable roosting habitat for Indiana bats does not exist within the project area. Forests surrounding the BRF were not assessed for their suitability as roosting sites for the Indiana bat using a modified version of the Indiana Bat Habitat Suitability Index Model (Romme, et al., 1995). Indiana bats forage in a variety of habitats. They are known to forage in riparian areas (Humphrey, et al., 1977; LaVal and LaVal, 1980; Kessler, et al., 1981; Brack, 1983), woodlots (Mumford and Cope, 1958), and upland forests (Easterla and Watkins, 1969; LaVal, et al., 1977; LaVal and LaVal, 1980; Brack, 1983). Indiana bats have been captured in mist nests along disturbed, fragmented riparian forests (Bowles, 1981; Clark, et al., 1987). This type of habitat exists within the project area. The closest known Indiana bat cave is over 14 miles from the BRF. This winter hibernaculum is considered historical and is no longer used by the Indiana bat. It is highly unlikely that Indiana bats forage in the area of BRF, since there is no known active winter hibernaculum in the area. If they do forage within the boundaries of the BRF, the proposed project is not expected to disturb this habitat. No impacts are expected to this species.

3.12. Endangered, Threatened, and Rare Species (Aquatic)

3.12.1. Affected Environment

A search of the TVA Natural Heritage database indicated that 11 mussel species, one snail species, and four fish species with either federal or state status, or considered sensitive by the state of Tennessee, are historically known from Melton Hill Reservoir (Clinch River) in the vicinity of BRF (Table 3-18). Seven of the mussel species and one of the fish are also federally listed as endangered or threatened (Table 3-18). None of these species have been collected from Worthington Branch or the small, unnamed tributary that runs through the existing bottom ash disposal area.

Only five of these species, spectaclecase, slabside pearlymussel, Tennessee clubshell, highfin carpsucker, and blue sucker, have been collected in the Clinch River since 1980. The remaining species have not been recently collected in the Clinch River or its tributaries. The Clinch River adjacent to BRF has been disturbed by past activities related to the construction of the cooling water intake and outfall canals for BRF. The area immediately downstream of the cooling water outfall canal has been significantly altered by fill activities at the two bottom ash disposal areas, and likely does not contain suitable habitat for mussels. None of these species are likely to occur in the Clinch River adjacent to BRF due to past in-stream disturbance from construction of BRF cooling water channels, and the BRF bottom ash disposal area located immediately downstream of the plant site. The bottom contour in this area is relatively steep, with slopes ranging from 14 percent to 30 percent, and does not contain suitable habitat for mussels.

Table 3-18. Sensitive Aquatic Species Historically Reported From the Clinch River and its Tributaries in Anderson and Knox Counties, Tennessee

Common Name	Scientific Name	Federal Status	Tennessee Status
Mussels			
Spectaclecase*	*Cumberlandia monodonta*	-	No Status
Slabside pearlymussel*	*Lexingtonia dolabelloides*	Candidate	No Status
Tennessee clubshell*	*Pleurobema oviforme*	-	No Status
Dromedary pearlymussel	*Dromus dromas*	-	Endangered
Shiny pigtoe pearlymussel	*Fusconaia cor*	Endangered	Endangered
Fine-rayed pigtoe	*Fusconaia cuneolus*	Endangered	Endangered
Cracking pearlymussel	*Hemistena lata*	Endangered	Endangered
Pink mucket	*Lampsilis abrupta*	Endangered	Endangered
Birdwing pearlymussel	*Lemiox rimosus*	Endangered	Endangered
White wartyback	*Plethobasus cicatricosus*	Endangered	Endangered
Orange-foot pimpleback	*Plethobasus cooperianus*	Endangered	Endangered
Snails			
Spiny riversnail	*Io fluvialis*	-	No Status
Fish			
Highfin carpsucker*	*Carpiodes velifer*	-	NMGT
Blue sucker*	*Cycleptus elongatus*	-	Threatened
Yellowfin madtom	*Noturus flavipinnis*	Threatened	Endangered
Tennessee dace	*Phoxinus tennesseensis*	-	NMGT

***** - recent collection (since 1980) indicates that this species is likely still present in the Clinch River
No Status - species considered sensitive by the state of Tennessee, but with no official listing status
NMGT - species deemed in need of management by TWRA

3.12.2. Environmental Consequences

No Action Alternative
If the No Action Alternative were adopted, there would be no construction, and no impacts to protected aquatic species.

Action Alternative
Impacts Common to All Options
Under the Action Alternative, approximately 1000 feet of a small tributary drainage that flows between the two ash disposal areas and empties directly into the Clinch River would be eliminated. This would provide storage area for the expansion of the existing bottom ash disposal area and provide an area to store CCBs produced from the use of this scrubber facility under the Action Alternative. This waterway has been heavily impacted by past encapsulation and channelization, and does not contain suitable habitat for state- or federally listed aquatic species. This activity would have direct impacts to aquatic resources in this area, but would not impact any state- or federally listed aquatic animals.

Options for Limestone Receiving
Option 1 would receive limestone via trucks, with the hopper located east of the surge bins. Some site preparation would be needed, such as grading, if this option were chosen. A new retaining wall may be added to alleviate traffic congestion just below the road to the current coal rail unloading facility. All activities would be conducted using BMPs to minimize potential impacts to surface waters in Worthington Branch, a small unnamed tributary to the Clinch River, or the main stem of the Clinch River (Melton Hill Reservoir). Because this alternative would not result in significant impacts to surface waters, no impacts to protected aquatic species would occur.

Option 2 would receive the limestone via barges on the Clinch River. Construction of a barge unloading facility would be necessary. The barge terminal would be located in the vicinity of the existing (undeveloped) unloading area that has been used to offload heavy equipment for the BRF SCR installation. This section of the Clinch River has been impacted by both construction and operation of the cooling water outfall from BRF and construction and operation of the bottom ash disposal areas immediately downstream of the cooling water outfall. Bottom profiles of the Clinch River in this area indicate that there are at least two options for placement of this unloading facility that would not require dredging.

Because of the possible need to dredge in order to provide suitable channel depth for barge traffic, this option has the highest potential to impact sensitive aquatic resources. Dredging activities required for maintenance of the navigation channel and construction of docking and mooring facilities would have direct in-stream impacts and would potentially impact protected mussels in the Clinch River (Melton Hill Reservoir). The area to be disturbed lies along the existing bottom ash disposal area. This section of the Clinch River has historically been impacted by fill activities from bottom ash storage, and the thermal regime in this stretch of river is directly impacted by cooling discharge from BRF. Suitable habitat for listed mussel species is not likely to be present in the areas that would be disturbed during construction and operation of the barge unloading facility.

Option 3 is rail delivery of the limestone. Under this option, two new rail lines would be constructed on the northern side of the existing rail line to accommodate 20 rail cars. A new truck road would also be constructed. This option would have effects on Worthington

Branch, especially on the upper end where approximately 350 feet of stream might have to be moved or enclosed in a culvert. Additional, smaller impacts may also be caused by creation of an area for limestone stockout. Because no protected aquatic animals are present in Worthington Branch, no impacts to protected aquatic animals would occur under this option.

Impacts From Construction and Operation of the Scrubber Facility, Railway Unloading Area, and Truck Unloading and Access Improvements

Construction of the proposed scrubber facility and associated rail or truck support facilities would not result in any significant changes to water quality in the Clinch River with the implementation of standard BMPs during construction of the facility. No impacts to protected aquatic animals that are known from the Clinch River would occur under these activities.

Impacts From Operation of the Scrubber Facility

Operational discharges from cooling systems and settling ponds associated with this facility would be permitted under the existing NPDES Permit and would have no adverse effect on water quality in the Clinch River. Therefore, the Action Alternative would not have any direct or indirect impacts on sensitive aquatic animal species and would not affect the habitats of endangered, threatened, or other protected species in the Clinch River.

3.13. Endangered, Threatened, and Rare Species (Plants)

3.13.1. Affected Environment

Review of the TVA Natural Heritage database indicated that no federally listed and 16 Tennessee state-listed plants are known within 5 miles of the proposed project (Table 3-19). These species, as well as federally and/or other state-listed species not presently known within the 5-mile radius, were sought within areas that would be impacted by the proposed project.

3.13.2. Environmental Consequences

No Action Alternative

No project-related impacts to rare plant species would result from the adoption of the No Action Alternative.

Action Alternative

No occurrence of federally listed or state-listed plant species were encountered in or adjacent to the proposed project area. Therefore, no impacts to federally listed or state-listed plant species are anticipated as a result of the proposed action.

No federally listed or state-listed species were observed within the areas to be impacted by the proposed project.

Table 3-19. Listed Federal and State Plant Species Reported Within 5 Miles of Proposed Project at Bull Run Fossil Plant

Common Name	Scientific Name	Tennessee State Status	Federal Status
American Ginseng	*Panax quinquefolius*	S-CE	-
Appalachian Bugbane	*Cimicifuga rubifolia*	T	-
Branching Whitlow-Wort	*Draba ramosissima*	S	-
Butternut	*Juglans cinerea*	T	-
Canada Lily	*Lilium canadense*	T	-
Goldenseal	*Hydrastis canadense*	S-CE	-
McDowell Sunflower	*Helianthus occidentali*	S	-
Michigan Lily	*Lilium michiganense*	T	-
Northern Bush Honeysuckle	*Diervilla lonicera*	T	-
Northern White Cedar	*Thuja occidentalis*	S	-
Prairie Goldenrod	*Solidago ptarmicoides*	E	-
Red Iris	*Iris fulva*	T	-
Spreading False-Foxglove	*Aureolaria patula*	T	-
Tall Larkspur	*Delphinium exaltatum*	E	-
Waterweed	*Elodea nuttallii*	S	-
Willow-Herb	*Epilobium ciliatum*	PT	-

S – Special Concern, T – Threatened, E – Endangered, S-CE – Special Concern Commercially Exploited, PT – Proposed Threatened

3.14. Wetlands

3.14.1. Affected Environment

An on-site wetland survey of the locations of the scrubber and its various support components at BRF was conducted on November 9, 2004, by TVA Natural Heritage contract wetland scientists.

On-site wetland determinations were performed according to USACE standards (Environmental Laboratory, 1987) for federal jurisdictional wetlands, which are regulated under the Clean Water Act. The USACE wetland standards require documentation of hydrophytic vegetation (United States Fish and Wildlife Service [USFWS], 1996), hydric soil, and wetland hydrology. Broader definitions of wetlands, such as the wetland definition used by the USFWS (Cowardin, et al., 1979), the Tennessee definition (Tennessee Code 11-14-401), and the TVA Environmental Review Procedures definition, were also considered in this review.

No wetlands were found within the footprint of the proposed BRF scrubber project area.

3.14.2. Environmental Consequences

Activities in wetlands are regulated under the Clean Water Act. Section 404 implementation requires authorization through either a Nationwide General Permit or an Individual Permit from the USACE in order to conduct specific activities in wetlands. Section 401 gives states the authority to certify whether activities permitted by the federal government are in accordance with state water quality standards (Strand, 1997). Additionally, Executive Order 11990 requires all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands, in carrying out the agency's responsibilities.

Since no wetlands were identified within the footprint of the proposed BRF scrubber project, any potential wetland impacts resulting from the construction and operation of the BRF FGD scrubber are expected to be insignificant.

3.15. Natural Areas

3.15.1. Affected Environment

A review of the TVA Natural Heritage database indicated that the area potentially affected by the proposed FGD project at BRF is not within or immediately adjacent to any Managed Areas and/or Ecologically Significant Sites. However, the proposed project area is within a Nationwide Rivers Inventory (NRI) stream, within 0.5 mile of four Managed Areas, and within 3 miles of 21 additional Managed Areas and/or Ecologically Significant Sites, primarily TVA Habitat Protection Areas and municipal and county parks.

Nationwide Rivers Inventory Stream Within Proposed Project Area

- The **Clinch River** is listed on the NRI and is within the area potentially affected by the proposed scrubber work at BRF (proposed project area). A 26-mile segment of the Clinch River from CRM 47 above Melton Hill Lake to CRM 73 below Norris Lake is an NRI-listed stream. The National Park Service recognizes the stream for its scenic, recreational, geologic, fish and wildlife, historic, and cultural values. It is noted for its numerous recorded archaeological sites, its steep ridges, long shallow shoal areas, and deep pools. Its upper reach is an excellent pastoral float stream, and it provides habitat for the most diverse mussel fauna in the world.

Managed Areas Within 0.5 Mile of Proposed Project Area

- **Haw Ridge Park** is approximately 0.2 mile west of the proposed project area. Managed by the Oak Ridge Parks and Recreation Office, this 780-acre park lies on the shore of Melton Hill Lake directly across from BRF. The park is a wilderness area covered by hardwoods and some cedar, pines, and hemlock. It is habitat for abundant wildlife. Used as a public park and for public recreation, the park has over 18 miles of trails and 4 miles of shoreline and provides a popular gathering place for avid bikers, hikers, equestrians, and canoers.
- **Melton Lake Greenway** is approximately 0.2 mile from the proposed project area. It is one of several greenways in Oak Ridge, which are linear parks or open spaces established along natural corridors, that provide quiet walkways and bicycle paths. An 8-foot-wide asphalt trail paralleling Melton Hill Lake, it connects with trails in Haw Ridge Park.
- **Bethel Valley Embayment TVA Habitat Protection Area (HPA)** is approximately 0.3 mile west of the proposed project area. This 4.19-acre area features some limestone outcropping and a forested wetland. It provides habitat for tall larkspur (*Delphinium exaltatum*), false foxglove (*Aureolaria patula*), and Canada lily (*Lilium canadense*).
- **Oak Ridge National Laboratory (ORNL) Reservation and Potential National Natural Landmark** is approximately 0.3 mile from the proposed project area. Managed by DOE, this 58,000-acre area has about 25,000 acres that are used for ecological research and commercial forest management. The ORNL lands contain good to excellent ecological types and are endowed with state and national rare

plants. The National Natural Landmark program was established in the 1970s by the U.S. National Park Service to identify nationally significant examples of ecologically pristine or near pristine landscapes. This area, while meeting the criteria for listing, has not to date been registered as a National Natural Landmark.

Area/Sites Within 3 Miles of Proposed Project Area

- **Bull Run Park** is approximately 0.6 mile from the proposed project area. A small 3.8-acre park on the south side of Bull Run Creek, it is managed by the Anderson County Conservation Board.
- **Chestnut Ridge Park** is approximately 0.7 mile from the proposed project area. Managed by the city of Oak Ridge, this park is near CRM 49.
- **Pumping State Embayment TVA HPA** is approximately 0.7 mile from the proposed project area. It is an approximately 6-acre narrow strip of shoreline with low wooded outcrops of limestone. It provides habitat for the false foxglove.
- **Chestnut Ridge Bluff TVA HPA** is approximately 0.9 mile from the proposed project area. A 10-acre area, it features a steep, north-facing bluff with deciduous forest and provides habitat for bush honeysuckle (*Diervilla lonicera*) and bugbane (Cimicifuga *rubifolia*).
- **Wolf Creek Embayment TVA HPA** is approximately 0.9 mile from the proposed project area. This HPA at CRM 48.8 is a small area of deciduous forest with some limestone outcrops. It provides habitat for false foxglove.
- **Brushy Valley Park** is approximately 0.9 mile from the proposed project area. This small 9.8-acre park is on the north side of Bull Run Creek and is managed by the Anderson County Conservation Board.
- **Railroad Slope TVA HPA** is approximately 0.9 mile from the proposed project area. This HPA features a steep slope with deciduous forest. It provides habitat for butternut (*Juglans cinerea*).
- **Lower Bull Run Bluffs TVA HPA** is approximately 1.3 miles from the proposed project area. This 3.57-acre HPA features bluffs with deciduous forest and some rock outcrops. Ginseng (*Panax quinquefolius*) and saxifrage (*Saxifrage careyana*) occur here.
- **Oak Ridge Forest**, also known as the University of Tennessee (UT) Agriculture/Forestry Experiment Station, is approximately 1.5 miles from the proposed project site. Its 2260 acres feature interpretive nature trails and ecological points of interest.
  - The **UT Arboretum** is a 250-acre portion of the larger Oak Ridge Forest Experiment Station. It is a research, education, and demonstration project with a collection of more than 2500 native and exotic woody plant specimens. The UT Arboretum is approximately 2.7 miles from the proposed project area.
  - The **UT Arboretum Wildlife Observation Area** is within the UT Arboretum.
- **Pine Ridge Bluff TVA HPA** is approximately 1.5 miles from the proposed project site. This 4-acre area is a river bluff with a cliff covered with deciduous forest. It provides habitat for bugbane.
- **Oak Ridge Municipal Park** is approximately 1.8 miles from the proposed project site. This 53-acre park is managed by the city of Oak Ridge and parallels the lakeshore near CRM 50.

- **Upper Bull Run Bluffs TVA HPA** is approximately 1.9 miles from the proposed project site. This 22-acre HPA features a series of wooded bluffs with rock outcrops and some bottom areas. Ginseng, bugbane, and butternut are located here.
- **Emory Valley Greenway** is approximately 2.0 miles from the proposed project site. One of many linear parks managed by the city of Oak Ridge, it parallels a backwater area of Melton Hill Reservoir near Emory Valley Road and consists of a natural wooded path approximately 0.7 mile long.
- **Anderson County Wildlife Refuge** is approximately 2.1 miles from the proposed project area. This area, situated on the old Anderson County Poor Farm and located on the Clinch River approximately between River Mile 50.5 and 52, has been used by the Clinch River Environmental Studies Organization (CRESO) as an area of environmental education and long-term ecological research. CRESO was formed as a joint effort by Oak Ridge Schools, Anderson County Schools, Clinton City Schools, and DOE.
- **Pilot Knob Bluff TVA HPA** is approximately 2.5 miles from the proposed project area. This 1.7-acre HPA features deciduous woods and cliffs. It provides habitat for saxifrage.
- **Bull Run Wetland TVA HPA** is approximately 2.7 miles from the proposed project area. This 2.0-acre HPA is a small forested wetland with hay fields on two sides. It provides habitat for the southern rein orchid (*Plantanthera flava*).
- **Three Bend Scenic & Wildlife Management Refuge Area** is approximately 2.7 miles from the proposed project area. This 2920-acre area includes Solway Bend, Freels Bend, and Gallaher Bend on the north shore of Melton Hill Lake in Anderson County. This area is managed by TWRA as a conservation and wildlife management area.
- **Palisades Subdivision Embayment TVA HPA** is approximately 3.0 miles from the proposed project area. This 3.71-acre area features wetlands around an embayment. The area has undergone major disturbances, but wildlife is abundant (beaver, turtles, and wading birds). It provides habitat for red iris (*Iris fulva*).
- **Worthington Cemetery Cedar Barrens TVA Ecological Study Area (ESA)** is approximately 3.0 miles from the proposed project area. This 15-acre ESA is a mosaic of cedar barrens characterized by thin soils over limestone, wetlands, and pines. The ESA contains many plants characteristic of cedar barrens and its varied habitats attract birds, amphibians, small mammals, and odonates. An old cemetery is on site.

3.15.2. Environmental Consequences

No Action Alternative

Under the No Action Alternative, the FGD system at BRF would not be installed and SO_2 emissions would not be reduced. No impacts would occur to Managed Areas and/or Ecologically Significant Sites located in the vicinity of BRF. However, present levels of SO_2 emissions would potentially continue to contribute to a wide variety of health and environmental impacts in an area that abounds with protected habitats for plants and animals and specific areas that are managed for a wide variety of outdoor recreational activities.

Action Alternative
Under the Action Alternative, the FGD system at BRF would be installed. The proposed work could result in potential benefits for Clinch River, the NRI-listed stream, and the four Managed Areas within 0.5 mile of BRF because a reduction in SO_2 emissions could lessen acidity of area streams and contribute to the reduction of acid rain, which is known to damage plants and soils. Impacts to Managed Areas and/or Ecologically Significant Sites that are more than 0.5 mile away from BRF but within 3 miles of the proposed work would be temporary and insignificant.

3.16. Cultural Resources

3.16.1. Affected Environment

East Tennessee has been an area of human occupation for the last 12,000 years. This includes five broad cultural periods: Paleo-Indian (11,000-8,000 B.C.), Archaic (8000-1600 B.C.), Woodland (1600 B.C.-1000 A.D.), Mississippian (1000-1700 A.D.), and Historic (1700 A.D.-to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands.

In East Tennessee, during the seventeenth and eighteenth centuries, Europeans and Native Americans began interacting through the fur trading industry. European-American settlement increased in the early nineteenth century when the Native American removal was enforced. In December 1801, Anderson County was created from parts of Knox and Grainger Counties. The county was named after Joseph Anderson, a prominent U.S. Senator, and former territorial judge in Knoxville. Agriculture was the key occupation in the county's early history, but a small number of businesses supplemented subsistence farming. Land speculation, especially coal mining areas, began in the 1830s and continued throughout the nineteenth century. Once the county was linked to the regional railroad networks during the middle decades of the nineteenth century, coal mining became its leading industry. No major Civil War battles were fought in Anderson County. However, as in many other East Tennessee counties, local loyalties were divided between Union and Confederate sympathizers. In the 1930s and 1940s, the federal government made its presence known in Anderson County by the development of TVA and Oak Ridge. In 1933, President Franklin Delano Roosevelt signed the TVA Act into law and changed the Tennessee landscape, especially that of Anderson County. TVA launched its first major construction project with the building of Norris Dam, the planned community of Norris, and public parks at Norris and Big Ridge. The dam provided jobs, flood control, and electricity to Anderson County (Mielnik, 1998).

TVA proposes to reduce SO_2 emissions from the BRF by installing FGD equipment that employs the wet LSFO technology. The Area of Potential Effect (APE) is considered to be all areas affected by the limestone receiving, the redirection of traffic, laydown areas, the dewatering facility, and the gypsum and dredged ash disposal area. All of the areas within the APE have been previously surveyed or disturbed. A field review was conducted by TVA Cultural Resources to verify that the areas involved in this project were disturbed or fill.

3.16.2. Environmental Consequences

Under both alternatives, historic properties (*historic property* means any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places [NRHP]) located on federally owned lands are protected by the National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act. The NHPA Section 106 review process includes steps for identifying and evaluating historic properties, assessing effects of an undertaking on them, and consultation about ways to avoid, reduce, minimize, or otherwise address any possible adverse effects.

No Action Alternative
Under a No Action Alternative, no FGD or other system for SO_2 reduction from BRF would be installed. Thus, no ground-disturbing activities would occur and no historic properties would be affected.

Action Alternative
The Action Alternative includes limestone receiving, the redirection of traffic, laydown areas, the dewatering facility, the gypsum and dredged ash disposal area. There are three options for receiving limestone, which either include the use of truck, barge, or rail. Some of the options include the addition of culverts and a retaining wall in and adjacent to streams on the reservation. Based on previous disturbance in the area, all of these options proposed would have no effect on historic properties.

3.17. Socioeconomics

3.17.1. Affected Environment

BRF is located in Anderson County, Tennessee, near the city of Oak Ridge and a short distance from Knoxville. Anderson County is about 47 percent rural, with 53 percent of its population in the cities of Oak Ridge and Clinton. The distribution of employment in the county shows greater dependence on manufacturing than the state as a whole, with 23.5 percent of Anderson County employment, compared to 16.2 percent statewide. Conversely, Anderson County has a lower share in farming, transportation and public utilities, wholesale trade, and in the finance, insurance, and real estate sector. Total employment in Anderson County in 1997 was 45,977, including both full-time and part-time jobs in the county. The labor market area had 418,728 jobs. Based on current commuting patterns and on proximity, the labor market area is defined to include all adjacent counties.

Compared to its labor market area and the state, Anderson County has a larger share of its workers employed in professional jobs, technical jobs, and the more highly skilled blue-collar jobs. The county has a lower share in most other occupational categories. The labor market area has a somewhat larger share of its workers in managerial, professional, technical, and sales jobs than does the state as a whole.

Population
According to population estimates by the U. S. Census Bureau, Anderson County had a population in 1998 of 71,116, an increase of 4.2 percent since the 1990 Census of Population count of 68,250. The labor market area had a 1998 population of 721,655, an increase of 10.5 percent from the 1990 total of 652,881.

The population of Anderson County is largely white, 93.9 percent in 1998 according to estimates by the U. S. Census Bureau. The remaining population is largely black, 4.5 percent of the total. The Hispanic population is estimated to be 1.0 percent of the total. The labor market area is only slightly less white, with 92.4 percent white and 6.2 percent black. The state is less white at 82.2 percent white and 16.6 percent black.

Income and Employment
Per capita personal income in Anderson County in 1997 was $22,130 or 97.5 percent of the state average of $22,699 and 87.5 percent of the national average of $25,288. The level was somewhat lower in the labor market area as a whole, $21,863 or 96.3 percent of the state and 86.5 percent of the nation. There was considerable variability, however, among the counties in the labor market area, ranging from $12,965 in Morgan County to $24,688 in Knox County.

The largest source of earnings in Anderson County in 1997 was manufacturing employment, which contributed 34 percent of the total. While comparable data for services in Anderson County are not available because of confidentiality restrictions arising from the dominance of one large employer, it is estimated to contribute at least 26 to 28 percent of the total. The next largest sector was government, with 13.5 percent.

With a civilian labor force of 35,750 in 1998, Anderson County had an unemployment rate of 3.6 percent, the same as the rate in the labor market area, and below the state (4.2), and the nation (4.5). Through the first six years of the 1990s, Anderson County had lower unemployment rates than the labor market area. However, in 1996 and 1997, the rate became somewhat higher, especially in 1997 when the county rate was 5.5 percent, higher than the labor market area (4.6), the state (5.4), and the nation (4.9).

The distribution of jobs by industry in Anderson County is similar to that of earnings, with services and manufacturing the most important sources of jobs. However, due to average wage differences and a larger proportion of part-time workers, services and retail trade account for a larger share of jobs (about 47 percent) than of earnings.

3.17.2. Environmental Consequences

No Action Alternative
As discussed below, no significant socioeconomic impacts to employment, income, population, or community services and infrastructure would result from the proposed action.

Action Alternative
Employment
During the construction period, the most intense work activity would occur during construction outages. Outage workforce for the scrubber project would likely be about 300 for a few weeks at most, with somewhat fewer for a few weeks before and after the peak. As a result, total personnel on site during outages may reach levels as high as around two times the typical day shift at the plant. These employment spikes would be of short duration, spiking up and back down quickly, probably over a period of about 6 months. The total duration of the construction would take approximately 3.5 years to complete. For a few months before and after the outages, a smaller number of additional workers may be on site performing construction-related work.

Based on experience at previous TVA construction projects and on the site's proximity to a fairly large labor force, it is estimated that more than 50 percent of these workers would live in the general area, close enough that they would commute rather than move, depending on worker needs elsewhere in and out of the Valley. The remaining workers would move to the general vicinity of the plant.

Income

The cost of labor for this unit is expected to be about $35 million dollars, which would be about 2.6 percent or less of total wages in Anderson County. It is likely that many of the workers would commute from other counties, however, resulting in a smaller impact on Anderson County. Spending by movers would have a small but positive impact on income in the county and surrounding area. Some individual businesses might experience substantial increases in sales.

Population

Assuming that 50 percent of the workers would move into the area, the maximum impact on population at any one time would be about 300 workers plus whatever family they brought with them. As noted above, the peaks would be of very short duration, spiking up and down over a period of about 1-2 months. Because of this short duration, the number of family members who would move with the workers probably would be lower than for longer-term construction jobs. It is likely that the maximum population impact at any one time would be somewhere around 300 persons, less than 1 percent of the current population of Anderson County. However, not all of these workers would locate in Anderson County. The distribution of this population among counties and within counties would depend largely on the availability of housing or of sites for trailers. Locations near the site or near shopping and other amenities would generally be preferred.

Community Services and Infrastructure

Impact on community services, such as police, fire, and medical, would be small because of the small size of the impact on population and because of the short duration of the maximum impact.

3.18. Environmental Justice

3.18.1. Affected Environment

The part of Anderson County where the plant is located, Census Tract 213.02 (a Census of Population subcounty geographic unit), has a small minority population (2.8 percent), and 14.7 percent of the population has income below the poverty level. The immediate area around the plant has a considerably lower share of minority population and of persons below the poverty level than does the state as a whole (Table 3-20).

Table 3-20. Plant Vicinity Demographics for Minority and Low-income Populations

Distance From Site	Total Population, 1990	Minority Population (Nonwhite and White Hispanic) (Percent)	Low-income Population (Percent Below Poverty Level)
3.6 miles	15,754	4.1	9.2
6.9 miles	67,523	5.6	10.5
Tennessee	4,877,203	17.4	15.7

3.18.2. Environmental Consequences

No Action Alternative
Under the No Action Alternative, the BRF would likely remain in its current state. Therefore, no impacts to any residents are expected.

Action Alternative
The proposed action would physically be a minor addition to an expansive heavy industrial facility having a significant property buffer area. Therefore, there is low potential during construction for important impacts on any of the residents of the surrounding area, and there are unlikely to be any disproportionate impacts to minority or low-income populations. On the other hand, all the residents of the surrounding area, including minority and low-income residents, would benefit from the resulting reduction in SO_2.

In general, operational impacts would be minor and not noticeable to residents of the surrounding area. Demographic data for areas around the site indicate that there would be no disproportionate impacts to minority or low-income populations.

CHAPTER 4

4. LIST OF PREPARERS

4.1. NEPA Project Management

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Involvement: NEPA Compliance, Document Preparation, and Solid Waste and Groundwater Sections

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Involvement: Terrestrial Ecology (Plants) and Endangered, Threatened, and Rare Species (Plants)

W. Chett Peebles
Position: Landscape Architect
Involvement: Visual Resources

Barbara Rosensteel
Position: Contract Biologist
Involvement: Wetlands

Edwin M. Scott
Position: Aquatic Zoologist
Involvement: Aquatic Life

Jan K. Thomas
Position: Contract Biologist
Involvement: Natural Areas

Cassandra L. Wylie
Position: Program Manager, Environmental Technology
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CHAPTER 5

5. LIST OF AGENCIES AND PERSONS CONSULTED

Federal Agencies

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Mr. Dale A. Ditmanson
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CHAPTER 6

6. SUPPORTING INFORMATION

6.1. Literature Cited

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6.2. Abbreviations and Acronyms

<	Less Than
<=	Less Than or Equal To
>	Greater Than
>=	Greater Than or Equal To
AADT	Average Annual Daily Traffic
APE	Area of Potential Effect
ARAP	Aquatic Resource Alteration Permit
BART	Best Available Retrofit Technology
BMP	Best Management Practice
BRF	Bull Run Fossil Plant
CCB	Coal Combustion Byproduct
CCW	Condenser Cooling Water
CFR	Code of Federal Regulation
CO	Carbon Monoxide
COF	Colbert Fossil Plant
CRESO	Clinch River Environmental Studies Organization
CRM	Clinch River Mile
CUF	Cumberland Fossil Plant
dBA	Decibel, A-Weighted
DEA	Draft Environmental Assessment
DOE	U.S. Department of Energy
DSN	Discharge Serial Number
EA	Environmental Assessment
EPRI	Electric Power Research Institute
ESA	Ecological Study Area
FGD	Flue Gas Desulfurization
FHWA	Federal Highway Administration
FRP	Fiber-Reinforced Plastic
ft-msl	Feet Mean Sea Level
gpm	Gallons per Minute
HEC-RAS	Hydrologic Engineering Center River Analysis System
HPA	Habitat Protection Area
ISCST3	Industrial Source Complex 3
KIF	Kingston Fossil Plant
km	Kilometer
kV	Kilovolt
lead	Pb
lb	Pound
Leq	The Continuous Equivalent Sound Level or the “Average” Noise Level During the Measurement Period
LOS	Level of Service
LSFO	Limestone Forced Oxidation
MaxP	Maximum peak sound level during a measurement for noise
mgd	Million Gallons per Day
mg/L	Milligrams per Liter
mmBtu	Million British Thermal Units
MVA	Megavolt Ampere
MW	Megawatt
NAAQS	National Ambient Air Quality Standards

NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
O_3	Ozone
ORNL	Oak Ridge National Laboratory
PAF	Paradise Fossil Plant
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter Whose Particles are Less Than or Equal to 2.5 Micrometers
PM_{10}	Particulate Matter Whose Particles are Less Than or Equal to 10 Micrometers
ppm	Parts per Million
SAMI	Southern Appalachian Mountains Initiative
SCR	Selective Catalytic Reduction
SFI	Sport Fishing Index
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SR	State Route
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
$\mu g/m^3$	Micrograms per Cubic Meter
US	United States Highway
U.S.	United States
UT	University of Tennessee
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WET	Whole Effluent Toxicity